1871. Mr. B. G. Sheridan, a police magistrate at Cardwell, told that his son had taken his evening stroll with his terrier when the dog suddenly took up a scent and followed it for about a mile. The encounter was brief and inconclusive and described by the boy with the following words:

> It was lying in the long grass, and was as big as a native dog. Its face was round like that of a cat. It had a long tail and its body was striped from the ribs under the belly with yellow and black. My dog flew at it, but could not throw him. The animal ran up a leaning tree. It then got savage and ran down the tree at the dog and me. I got frightened and came home.

Australian naturalists are quite willing to concede the possibility that there is a large unknown catlike mammal (probably a marsupial) hiding in the only sketchily explored forests of the York peninsula which, after all, has roughly twice the area of England. The people living there speak of it matter-of-factly, like the Australian writer Ion Idriess:

> Up here in York peninsula we have a tiger-cat that stands as high as a hefty medium-sized dog. His body is lithe and sleek and beautifully striped in black and grey. His pads are armed with lance-like claws of great tearing strength. His ears are sharp and pricked and his head is shaped like that of a tiger. My introduction to this beauty was one day when I heard a series of snarls from the long buffalo grass skirting a swamp. On peering through the grass I saw a full-grown kangaroo, backed up against a tree, the flesh of one leg torn clean from the bone. A streak of black and grey shot towards the kangaroo's throat, then seemed to twist in the air, and the kangaroo slid to earth with the entrails literally torn out. In my surprise I incautiously rustled the grass and the great cat ceased the warm feast that he had promptly started upon, stood perfectly still over his victim and for ten seconds returned me gaze for gaze. Then the skin wrinkled back from the nostrils, white fangs gleamed and a low growl issued from the throat. I went backwards and lost no time getting out of the entangling grass.—The next brute I saw was dead, and beside him was my prized staghound, also dead. . . .

Frank W. Lane found another report in the *Brisbane Courier* (unfortunately he neglected to give the date) which seems to be quite recent, telling of two men who came across such an animal at close range but in a torrential rain. Their description, however, agrees well

with those quoted—there can be little doubt that a large North Australian carnivore still awaits official discovery and detailed description.

Before proceeding to the classical continent of undiscovered animals, Africa, some marine mysteries of the Pacific Ocean might be mentioned as briefly as is consistent with stating their case. One of these stories comes from the immediate vicinity of Australia, specifically from the Timor Sea, the expanse of water between the long island of Timor to the north of Australia and the mainland. This sea, the natives claim, is inhabited by a large, ferocious man-eating shark. It is larger, they say, than the well-known man-eating shark. Of course, there are a number of sharks that grow bigger than the man-eater, but these are not man-eaters. This mysterious fish is said to differ from other sharks in one important and conspicuous point: it does not possess the typical triangular fin on its back; yet it is definitely a shark. It is said not to swim at the surface of the sea but to lie in wait on the bottom. Consequently, the natives call it the "ground-shark."

To deny the truth of this story would be to assert that every fish in the seven seas is known to science, and recent events have cautioned even the greatest skeptics (they should be called optimists, rather) not to be too dogmatic in making such statements.

A few years after the conclusion of the First World War a scientist returned from a lonely but famous island in the Pacific Ocean with a tale about an animal that had never reached the white world, not even in the form of a rumor. Professor J. Macmillan Brown had spent several years on Easter Island investigating the incompletely known history and migrations of its inhabitants. He was not, as a matter of fact, much interested in animals, but when he came across references to a creature of which he had never even heard, his curiosity was aroused. The animal's name was given as *niuhi* by the Easter Islanders, a word for which there is no known equivalent in English or any other civilized language. Professor Brown at first thought that the "*niuhi*, the only animal that inspires the Easter Islanders with terror," was some local species known to science, but soon he and the other Europeans on the island found out that it was not.

> It is not a shark; the Easter Island shark (*mongo*) does not seem to be a man killer. It is not a whale (*taoraha*); for besides the large mouth that

is one of its prominent features it has a large throat capable of swallowing a man and sharp teeth capable of lacerating him.

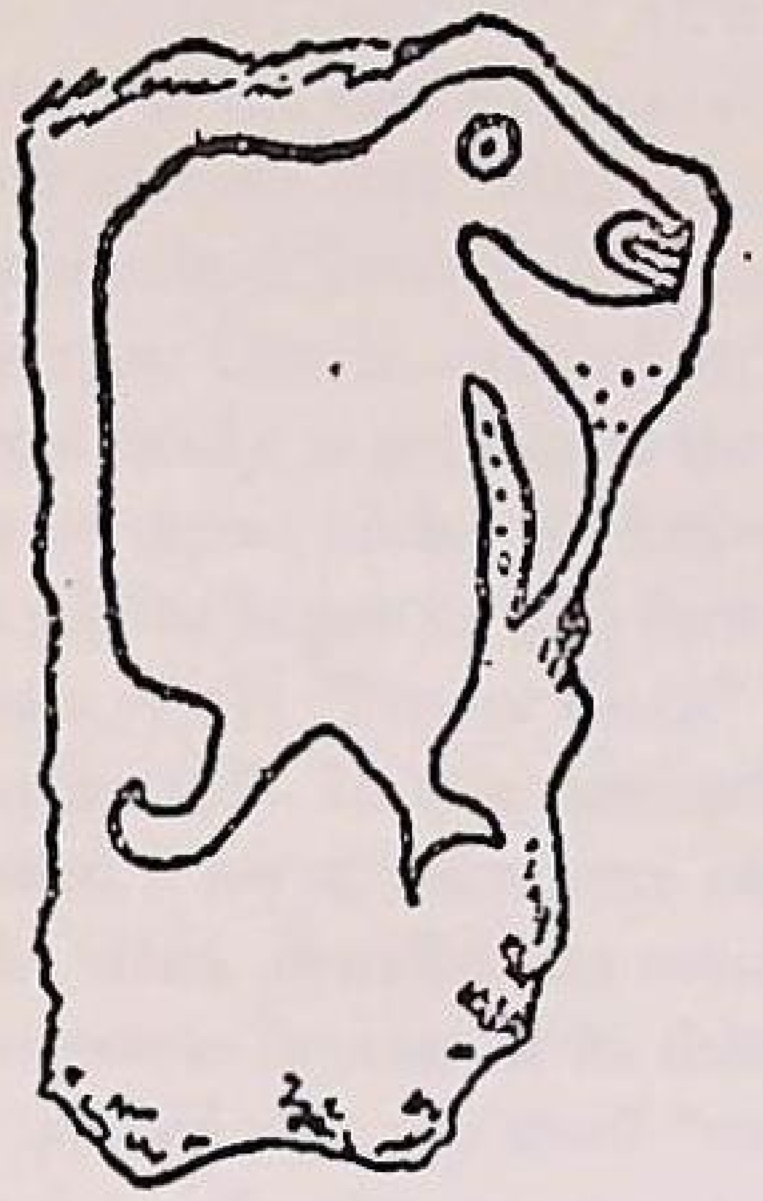
Questioning and cross-questioning of every Easter Islander who professed to know something about the *niuhi* finally resulted in the following description:

> The animal is about 30 feet long and is also very broad even in the head. Its arms are at least four feet long, stretching from the shoulders or below the head; when swimming these are stretched behind the neck; but when in action they are thrust forward towards the prey, which it enfolds with them and draws towards its capacious mouth; the natives call them *rape*, whilst its claws or hands they call *kara*. It generally swims in pairs and it has a pilot-fish which the natives call *mama niuhi*. My informant encountered one when out fishing in a boat. He had hooked a large *kahi*, or tunny, and as he drew it in he saw the monster following it with its arms outstretched; by the time it reached the surface and was near the boat it had swallowed the fish and still pushed on. They struck it vigorously on the head with the oars and at last it dived. Again, on the island itself he and some others saw a *niuhi* approaching; the sun was behind them and threw their shadows on the water; it snapped at the shadows and disappeared.

The veracity of a number of stories told by the natives, including one that deals with two men swallowed whole by a *niuhi* and soon afterward disgorged alive though not exactly sound, may reasonably be doubted. But the natives, at any rate, are convinced that the animal exists, although it is not very numerous in the vicinity of Easter Island. While Professor Brown was not quite able to form an opinion about whether to believe in the reality of the *niuhi,* he succeeded in finding a native picture of one, brought to civilization by the *Mohican* party.

Although this mention of what is probably an unknown sea mammal is certainly the first as far as Easter Island is concerned, I do not think that it is quite the first report on it. In June 1890 Miss S. Lovell, then a schoolteacher living at Sandy Cape, Great Sandy Island, Queensland, Australia, reported that she had seen an unknown animal which might well have been of the same kind as the Easter Island *niuhi.* Miss Lovell, in describing her animal, called it a "monster turtle fish" and wrote that it let her stand for half an hour within five feet of it.

> When tired of my looking at it, it put its large neck and head into the water and swept round seaward, raising its huge dome-shaped body about five feet out of water, and put its twelve feet of fish-like tail over the dry shore. . . . It has either teeth or serrated jaw-bones. Native blacks call it *moha-moha* and say they like to eat it and that it has legs and fingers. I did not see its legs as they were in the water. What I saw of it was about 27 or 28 feet, but I think it must be 30 feet in all. Whilst its head was out of water it kept its mouth open . . . the jaws are about 18 inches in length. The body was dome-shaped, about eight feet across and five feet high, smooth and slate-gray in color. Tail about 12 feet, the fish-part wedge-shaped and fin of chocolate-brown.



Unidentified picture from Easter Island, presumably the *niuhi.* The original is a painted stone, brought to England by the *Mohican* party

It might be added here that the Easter Islanders told Professor Brown that they had caught young *niuhis* which had a dark-blue smooth skin. When Miss Lovell's report was doubted, she could not only furnish the testimony of five other white people who had seen the animal in the same locality within a week's time of her own observation, but she also began to question the natives. She wrote:

> The blacks who had not seen it on the day I did named it at once from my sketch and called it *moha-moha* and laughed and said, "Saucy fellow,

Meebee." . . . It is eight years since it attacked the blacks' camp. It can stand upright and it put its legs on the shoulders of a powerful black, six feet high, and knocked him down. That year it invaded their camp, and nearly caught one man by the leg. For months after the blacks camped inland.

Although people in Queensland have been on the lookout for the *moha-moha* since that time, no additional report has ever come in. But that absence of additional evidence is not quite sufficient reason for doubting the word of a number of obviously sincere and intelligent white people who could gain nothing from such a story. And it is hard to be mistaken about the appearance and dimensions of an animal that has been viewed in bright sunshine at a distance of five feet for half an hour.

Whether the *moha-moha* is an unknown kind of large marine turtle or a somewhat strangely shaped marine mammal is, of course, impossible to say. But it seems to me a fairly reasonable hypothesis that the *moha-moha* of Queensland and the *niuhi* of Easter Island (which seems to be known under a similar name in the Marquesas Archipelago also) are the same. One day the animal may become definitely known, and be hailed as a great discovery and a "complete surprise to science."[1]

And now we come to the greatest rumor-breeding territory of all: Africa. This gigantic continent, the continent of endless deserts and even more endless tropical forests, of enormous rivers and horizon-spanning lakes, is literally alive with stories of undiscovered animals, animals ranging in size from tiny mice to a kind of river dolphin or river whale said to inhabit certain streams of the West Coast. The suspicions range in variety from unknown apes to (literally) still living dinosaurs. Of course not all of these rumors must necessarily be true, but some of them were, as has been shown by the discovery of the okapi and others. When the okapi burst as a surprise on the scien-

tific world just after the turn of the century, big-game hunters, zoologists, and animal dealers began to turn an attentive ear to other rumors . . . they might be true, after all.

In particular the files of Carl Hagenbeck, animal dealer at Stellingen near Hamburg in Germany, were combed. Dubious reports of tales told by natives were often brought back from Africa by Hagenbeck's collectors. There were articles in the files about animals that could not be classified, catalogues of animals that were described as living in Africa but that did not appear in delivery bills of the animal trade.

Interest began to center upon Liberia, situated on the Atlantic coast of the Dark Continent. Specifically, it pointed to the possible existence of an animal known only by report under the native name of *nigbve.* Slowly the history of this *nigbve* began to take form. First was found a description of the animals of the "Pepper Coast" (Liberia) written by the Dutch Dr. Dapper in 1688. In this description three varieties of wild hogs were mentioned. Two of them were comparatively abundant and well-known; the third, described as much larger than the others, black, and very dangerous because of its sharp teeth, presented a puzzle. Then someone guessed that this third "wild hog" might be the same animal described in 1844 by an American physician, Dr. Samuel G. Morton.

Dr. Morton had acquired a single skull, which, he had been told, belonged to an animal that looked like a large pig. Morton saw at once that it was by no means a pig, but an animal related to the hippopotamus. The relationship did not seem to be very close, so Morton invented a special generic name: *Choeropsis.* The common name unfortunately became pygmy hippo, which makes it seem as if the *nigbve* of the Negroes were only a dwarf form—"only" six feet long—of the common hippopotamus. Actually the two are not "brothers" but only distant cousins, as Dr. Morton had deduced from the skull.

In the eighties complete specimens of the animal—killed by native hunters—were seen by the Dutchman Büttikofer and the German Schweizer. Büttikofer did not see the animal alive and for that reason the skins were mounted very faultily in several museums. For some

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[1] Evidence of a large and unknown animal, possibly a gigantic turtle, has turned up in Florida during the winter 1947-8. "Something" had tried to climb the sea wall, without success. The tracks looked like turtle tracks but were much too large and too far apart for anything known.

The *gastrophetes* of Ktesibios is the earliest example of which we have documentary evidence. But the crossbow did not become important until more than a thousand years later when somebody, flexing a fine sword, thought of substituting a steel bow for the wooden one.

ANOTHER LOOK AT ATLANTIS - and fifteen
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Dead or Alive?

DURING THE EARLY PART of the eighteenth century some very vague rumors about gigantic bones reached Paris. Unaccompanied by any evidence, these rumors traveled via Spain, for they originated from Argentina. Shorn of embroidery and conjecture, they stated that large bones could be found in the pampas. These were said to be as large as the bones of elephants.

The gentlemen of the Academy in Paris decided that it was best not to say anything. As far as anybody knew, there were no elephants in the Americas. Still, South America was not well explored yet, so—let the Spaniards prove their case if they have one.

It so happened that they did.

During the earlier years of the 18th century only occasional single bones had been seen by literate men, usually in places where a river cut into the soil of the pampas. In 1789 a complete skeleton was found, fortunately not too far from Buenos Aires, at a place called Lujan. The viceroy ordered that the bones be excavated and sent to Madrid. There a scientist named Garriga assembled them and, in 1796, published a first description.

The animal had been about the size of an elephant, or would have been if its legs had been a little longer. It stood eight feet tall at the shoulder and had an overall length of 14 feet.

The first thing that impressed Garriga was the legs, but not because they were beautiful. The bones were incredibly heavy, far more massive than the corresponding bones of an elephant. The tail was also very massive and long for a big animal (which usually have tiny tails) because it was long enough to just touch the ground. But while the comparison with an elephant was obvious because of the size, it broke down when it came to the foot skeleton and the skull. They did not resemble anything ever seen before, at least not in such a size. The skull showed clearly that this giant was a sloth.

Now it needed a name, which was compounded from the two Greek words for "large" (*megas*) and "mammal" (*therion*) in the Latinized version of *Megatherium americanum.*

Naturally things did not stop with this first skeleton. Pictures of it got into books, partly because it was the first and partly because it was so big.

More discoveries were made and scientists soon knew that there had been several species of giant sloth. The second species to be definitely established was *Mylodon robustus,* which was 11 feet long and differed from Megatherium mostly in having forelegs about as long as its hindlegs; in Megatherium the forelegs are a good deal longer than the hindlegs.

The third species was named *Mylodon gracilis.* Now the word *gracilis* would normally be translated as "dainty," but in this case the normal, or any other, translation just did not apply. The animal was by no means "dainty." It was a heavy-boned nine-foot monster.

It is possible that *gracilis* was used merely as the opposite of *robustus.* It is more likely that this name is a case of Teutonic humor, for the man who coined it was Professor Hermann Burmeister, of Germany, who had gone to South America on a trip of exploration and then decided to stay and settle down, mostly because of Megatherium and Mylodon.

Hermann Burmeister was fifty years old when he made this decision (in 1861 or 1862), but he still managed to enjoy thirty-one years of residence in the country he adopted for zoological reasons. When I state that he "enjoyed" these years, I do not use the term loosely. According to all accounts, life in Prof. Burmeister's house was friendly, witty and gay, and it was permanently open to any fellow scientist and any intelligent layman who was willing to talk Megatherium and other pampas fossils. That there could possibly ever be a shortage of domestic or imported wines never occurred to Burmeister, unless he had nightmares, which seems unlikely.

Burmeister's closest scientific associate and his successor (when Burmeister died in 1892 at the age of 85) was Professor Florentino Ameghino. Up to 1892, expert descriptions of pampas fossils had been in German; from then on, they were in Spanish. But behind all the scientific gaiety and the fun and thrill of a steady stream of discoveries there was one unanswered question. How old were the bones Burmeister and Ameghino dug up, cleaned, measured, assembled and described?

This question at that time was simply unanswerable, but Burmeister thought that while he could not name a figure, he could at least give an answer of sorts.

There was general agreement that man had originated in Asia and invaded the American double continent via the Bering Strait. This naturally meant that man had arrived in South America much later than in North America, since he had to traverse the length of the North American continent first. Any figures which were then mentioned were naturally guesses; man had probably arrived at the northern end of South America 3000 to 5000 years ago. Burmeister based his answer on this figure.

Man and Megatherium had never met, Burmeister was convinced, because the natives did not have any recollection of such animals and had invented a legend to account for the bones. They thought that the large animal was something like a gigantic mole which was instantly killed by sunlight if it inadvertently "broke surface."

Burmeister's ideas might have been well reasoned, but the facts were against him. Megatherium, the giant sloth, was very often associated with a giant armadillo—Glyptodon—and the two animals had obviously lived at the same time. But remains of Glyptodon and human artifacts were sometimes found together, and the prize discovery was a human skeleton sitting inside the giant carapace of a Glyptodon. This was certainly an ancient form of burial for somebody of importance. Finally, a skeleton of Megatherium was unearthed which was incomplete in a significant manner. The four legs were there and undisturbed, but most of the other bones were missing, and there had been a fire in the center, between the legs. It was perfectly apparent that here was a giant sloth that had been caught in a pit and roasted right in the trap from above.

There was no doubt then that the early South American Indians had known Megatherium "in the flesh," but it still did not answer the question: when had this happened?

In the meanwhile something else had taken place which did not seem to have a connection for a long time. By coincidence, another German who had made his home in South America figures in this section of the story, though not as prominently by far as Professor Burmeister.

Near the southern end of Patagonia there is a fjord or inlet —locally called a "canal"—with the gloomy name of Ultima Esperanza (Last Hope). There the retired German sea captain Eberhard bought himself some land and built a house. Visitors to the Eberhard ranch noticed that the hide of a large animal was hanging over some bushes. Some of these visitors—or so it was told later—tried to cut a piece off that hide, which proved to be extraordinarily difficult. The reason was that a large number of bean-sized "bones" were embedded in the hide. If any one of these visitors had been a naturalist, this fact would have done more than just make him suspicious; but evidently nobody, including Captain Eberhard, had any profound knowledge of natural history.

At some time—the date is uncertain, but it was after Burmeister's death—such a piece of skin reached Ameghino. It has never been established whether this particular piece came from the Eberhard ranch; Ameghino himself did not think so. The important thing was that this piece of skin was, or looked, fresh. Not fresh like animal skin in a butcher shop, but rather like untanned hide in a saddler's establishment. In any case it certainly was not fossil and Ameghino decided that logic, however incredible, had to prevail. A piece of Mylodon skin proved that the animal still existed somewhere.

Ameghino called a press conference. Newspapers around the world carried articles which declared: "The Giant Sloth Is not Extinct." The very fact that this animal, which for so many years had been so proverbially extinct, was supposed to be still alive set thought going in various directions at once.

Was there any evidence in addition to the piece of skin?

Did somebody in the past mention the giant sloth in any manner, probably with a native name which conveyed no meaning to readers elsewhere?

And, finally, where can they be found, to be captured for a zoological garden?

Professor Ameghino said that he did have additional evidence. Besides his piece of skin from an unknown source, there was the Ultima Esperanza hide. And then there was the story told by Ramón Lista, onetime Governor of Santa Cruz—he was later killed by Indians.

Lista reported that he had been with a hunting party in the interior of Patagonia. While camping at night, he and his party had seen an unknown animal which looked somewhat like a pangolin, except that it was covered with long hair.

The animal escaped, even though the hunters shot at it with their rifles.

Since Ramón Lista was a learned man with much experience in Patagonia (he wrote several books about his land which received high praise and are said to be still worthwhile reading), a story like this deserved attention. Strangely enough, Ameghino at first disregarded it, thinking that Lista must have been somehow mistaken. But then he suddenly changed his mind. A while later he even coined the scientific name *Neomylodon listai* (Lista's New Mylodon) and pointed out that it was quite possible that one or more of the hunters' shots had hit, but that they did no harm because of the bony nodules in a Mylodon's hide.

Then a native legend about a *Iemish* was dragged into the giant sloth debate and things really became confused. The *Iemish* was claimed to be a large beast that lived both on land and in the water, usually hiding in the water. It was a flesh-eater and drowned horses to eat them. Or else the *Iemish* was a beast the size of an ox that was harmless and nocturnal. During the day it slept in burrows which it had dug with its large claws. Finally somebody supplied Ameghino with a "translation" of the word *Iemish:* it was supposed to mean "the one with little stones on it." Ameghino thought that all this went together beautifully and could apply only to the *Neomylodon listai* that he had named.

All this, however, did not go together beautifully. An animal is either a flesh-eater, in which case it can't be called harmless, or it is harmless, in which case it is not likely to be a flesh-eater. But while this could be reasoned out by logic alone, it took an enormous amount of work to establish how the confusion had taken place.

The legend of the *Iemish*, the one that often retreats into the water and is a flesh-eater, refers essentially to the jaguar, which is a carnivore and does swim well. It probably also contains some confusion with the giant river otter of South America, which is of nearly the same size, is also carnivorous, like all otters, and, like all otters, lives in the water. The names which could be found in dictionaries that sound like *iemish* mostly are native words for "otter."

Of course the word does not translate the way Ameghino reported. It seems to be simply a name. But Ameghino, having been handed this significant-looking "translation" by somebody, made the mistake of applying the name *iemish* to the other legend about the ox-sized harmless nocturnal animal. (It might be added that the two legends did not exist in the same place. Their origins were 1500 or more miles apart.)

Ameghino, after having made this mistake, concluded that he had taken care of the question of available evidence. Then he set out to answer the second question; namely, whether the giant sloth might not have been mentioned by early writers on South America under another and probably native name. Here he was not only far more careful, he was also more successful.

He came across a book entitled *Historia de la Conquista del Paraguay, Rio de la Plata y Tucumàn* by Father Pedro Lozano, S.J., published 1740-1746, in which an animal *su* or *succarath* was mentioned. It was said to be large and to have the habit of carrying its young on its back. The natives were stated to hunt it in spite of the dangers involved, for they wanted its skin to make durable cloaks.

Hardly anybody in Europe had ever heard of Father Lozano before, but when Ameghino reported on the *su* in professional journals, all European zoologists had an automatic reaction. They knew the *su*. Its picture, however fantastic, was on the title page of the enormous zoology book by the Swiss savant Konrad Gesner which every one of the Europeans had read.

There in volume one of Gesner's *Historia animalium* (published in Zürich in 1955) one could find a paragraph headed *De Subo* ("Of the Su") which translates as follows:

> The Most Obnoxious Animal that might be seen, called Su in the New Lands. There is a place in the newly found land where lives a people calling itself in its language Patagones, and since the land is not very warm they cover themselves with fur from an animal they call Su, which means Water, by reason of its dwelling mainly near water. It is very dreadful, obnoxious, as may be seen. When hunted by the hunters, it take its young upon its back, covers them with its long tail and thus flees. It is caught in pits and killed with arrows.

This had made no sense until the fight about the still-living giant sloth started; now things had changed so that Gesner's paragraph *might* make an exciting kind of sense.

As long as nobody had paid much attention to Gesner's paragraph as a whole, even less attention had been paid to a note which said that this description had been taken from "Andreas Theuetus." Since Gesner wrote in Latin, it was only logical that he used the Latinized form; actually this was the name of André Thévet. Thévet's paragraph on the *Su* is the same as Gesner's naturally, but Thévet has one more sentence telling what happens after a su has fallen into a pit:

> When it sees that it is caught, it maims and kills its young (as if maddened) and gives such terrible cries that it makes the Savages very fearful and timid. Yet in the end they kill it with arrows and then they flay it.

Incidentally, each of the learned men made a linguistic mistake. Gesner did not know that the name of the Patagonians is not derived from their own language, and Thévet was wrong in thinking that *su* means water. Its meaning is "covering." Ameghino came close by translating *su* as "cloak." Thévet is the only literary source which might be construed as referring to a giant sloth. If one wants to accept it—and I don't see why not—one of the smaller forms of giant sloth must have been still alive in the southern part of South America during the Middle Ages.

There are two more things: Where did the hide on Captain Eberhard's ranch come from?

Well, Captain Eberhard himself located a cave some distance from his home. The cave was almost completely closed (one could just squeeze through) by a wall of boulders which was obviously piled up by people. Inside the cave, the amateur explorers found a human skeleton, two more hides, and what is generally called a kitchen midden. Later, professional investigators discovered Mylodon droppings over a foot deep, and when they went to work on these droppings, they saw that they contained ends of plant stalks which had been *cut*. The teeth of the animals could not have produced such a clean end.

One of the investigators, Professor Santiago Roth, then proposed to rename the animal *Grypotherium domesticum*, since the Indians had apparently domesticated it. This would not have been impossible by itself, but there is one major fact that speaks against the idea: domesticated animals do not become extinct! Man sees to it that they don't. If the Indians had widely domesticated the Mylodon, it would still be around with its masters. More likely the animals were just rounded up in the open and chased into the cave, where they were kept alive with forage until the time came to kill and eat them.

Before finishing up with the current scientific opinion about the whole matter, one episode, amusing in retrospect, must be told. Early in this century Sir Ray Lankester, director of the Natural History Museum in London, permitted himself to be quoted to the effect that it seemed possible that a ground sloth of the Mylodon type might still be alive in little-known parts of Patagonia.

Chapter 5

This was good enough for the owner of the London *Daily Express.* He decided to finance an expedition to Patagonia to search for a living Mylodon and bring it back to England, alive if possible, dead if it could not be helped.

The expedition was headed by a man named Hesketh H. Pritchard, who must have been an impatient type. Nobody knew at the time that Ameghino had blundered with respect to the *Iemish,* so Pritchard set out with what he believed to be a body of facts to guide him. In South America, he quickly learned that a major mistake had been made somewhere and he grew furious. Though he had traveled thousands of miles and had only another two or three hundred miles to go to reach Captain Eberhard's ranch, he did not do so. He turned around, went back to England and wrote perhaps the most ill-tempered book ever printed. The *Iemish* did not exist, the legend about it was the invention of some publicity seekers, the whole thing was a pack of lies and, most important, he, Hesketh H. Pritchard, had been hoaxed.

Well, how do things stand now?

One of the newer and most useful tools of science, radio-carbon dating, does not help much here for lack of material. The first list of radio-carbon dates (*Science,* February 2, 1951) contained two entries about giant sloth material. They were:

No. 484 *Chilean Sloth:* Dung of giant sloth from Mylodon Cave, Ultima Esperanza, Chile (51° 35′S.). Not associated with human artifacts, though sloth and man found together in three caves 125 miles distant (*cf.* sample 485) 10,800 ± 570; 10,864 ± 720; 10,832 ± 400 (years).

No. 485 *Chilean Bone:* Burned bone of sloth, horse and guanaco, associated with human bones and artifacts. Valuable in determining time of arrival of man at tip of South America. Material found in Palliaike Cave, 125 miles east of Mylodon. Comment: Most ancient of human samples from South America. 8639 ± 450.

In other words, the samples that happened to be dated are pretty old and do not help us in determining how long the giant sloth lived in South America. It would be so nice if we found a sample which at least makes it certain that Thévet's *Su* was a ground sloth.

Pritchard's expedition was not the last. Two others were organized. Both returned empty-handed. This, of course, is not proof that there are no living ground sloths any more; large portions of South America are still poorly known. And one can always argue that it is hard to see why a plant-eater should become extinct in green South America, where there have been no climatic changes for thousands of years. There is no answer to that argument except that no living, or freshly killed, ground sloth has yet turned up.

Another Look At Atlantis

and fifteen other Essays
by Willy Ley
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Chapter 6

bers, the zoologist R. Hesse, calculated that the completion of the work would take 270 years—provided that no new discoveries would be made during that time!

As regards predictions, let's start with the easiest place of all, the oceans. We *know* that there are unknown fish; they have been seen through the window of the bathysphere by William Beebe. They haven't been taken yet, but they will be.

Then, also in the oceans, there is the problem of the Great Sea Serpent which might be a mammal.

Thirdly, there seems to be a hitherto undiscovered long-necked and large marine turtle.

Taking the continents one by one, nothing specifically is rumored from North America. South America has many rumors emanating from it, but none specific enough to start theorizing. For a while, a kind of hunt was on for surviving giant sloths, but that has died down. Though South America will probably provide a number of novelties in time, there is no way of guessing what they might be. Europe can also be very nearly written off, except for a persistent rumor about a fairly large unknown lizardlike animal in the Austrian Alps.

Africa is a different story. There are rumors in quantity and they might very well be true.

One is usually referred to as "Nandi bear" (also as *chimiset*, *nunda* and *mngwa*—don't ask me how this should be pronounced), which probably is not a bear but a man-killing mammal, possibly feline.

The other is a river- or lake-dwelling killer of hippopotami, referred to as the *chipekwe*, or *mokéle-mbêmbe* and, possibly, *lau*. What can be learned always has a few things in common—the unknown animal lives in fresh water, but can go on land. It kills hippopotami, but does not eat them. It has a long neck. And somehow the impression of a reptilian nature is conveyed.

Passing on to Asia, the main mystery and possible next discovery is the *yeti* or "abominable snowman" whom the Sherpas describe as being the same size they are (average 5 ft. 6 in.) and covered with long-haired but very thin fur of a brownish color. It is possible that this is actually a very primitive human race. Elsewhere, primitive races have been pushed by their less primitive neighbors into environments that the less primitive peoples did not want themselves. This may well have happened in Central Asia to a primitive and somewhat peculiar-looking human type.

In Australia, there is one unknown animal that may be said to be almost known. It has been seen repeatedly in the northeast part of Australia, the Cape York Peninsula. It is rather matter-of-factly described as a "cat," as large as a strong medium-sized dog, with a head resembling that of a tiger. It is described as striped, black on gray, with sharp claws and pointed ears. One witness saw it kill a kangaroo.

The animal is obviously rare and its habitat restricted to a comparatively small area. It could be either a real "cat" from the description, a feline carnivore like a large lynx. Or else, which would be much more interesting if it turned out to be the case, it could be a marsupial carnivore like the Tasmanian Tiger.

New Zealand, finally, could harbor two more discoveries that would not be complete novelties because they have been rumored for so long. One is the Waitoreke, the only (but undiscovered) indigenous land mammal of New Zealand. The other, rumored from the Dusky Sound area, not too far from Takahe country, is a small Moa, the type called by scientists *Megalapteryx*. Like the Takahe, this *Megalapteryx* was known to the Maori and the most recent Moa remains known are of this type. Whether there are any left is doubtful, but not impossible.

Well, that's the story. Like all stories of discovery, it has no end, properly speaking, because the end consists of opening new vistas.

9

Hunting the Dodo

ONCE UPON A TIME, there lived on the island of Mauritius a bird named the dodo, with the scientific name of *Didus ineptus.*

Come to think of it, this is not a good beginning. The story of the dodo is not a fairy tale but the truth, or as much truth as can still be established. Moreover, this first sentence is a very unscientific oversimplification. Let's try to make it a bit more accurate. Then it will read just about like this:

From a period, the beginning of which cannot be ascertained, but which might be considered roughly equivalent to the beginning of the glacial age in higher latitudes, until about the year 1680 A.D., a large and flightless bird, classified as being the representative of a sub-order of the *Columbiformes* or pigeonlike birds, known to have existed on the island of Mauritius, or Zwaaneiland, also known as Ile de France, was called dodo, or dodaers, or dronte, but also *dinde sauvage, Walchvogel* or *gekapte Zwaan* (hooded swan) and several other names, with the scientific designation of either *Didus ineptus* or *Raphus cucullatus,* which are equivalent in scientific usage, but with *Raphus cucullatus* holding the chronological priority.

Well, now, this is more accurate.

It also complies with the order drilled into newspapermen: "Get all the facts into the first paragraph."

But I'm very much afraid it would probably be most intelligible to somebody who knows these facts already and who, logically, does not have much reason to read it at all.

I had better start over again, this time with the fundamentals. To the east of Madagascar, strung out along the 20th parallel of southern latitude, there are three reasonably large islands.

Their current names are Réunion, Mauritius and Rodriguez —at least, that's the way the name of the last appears on Admiralty charts, both British and American. For some unfathomable reason, the dependency of Rodrigues, when it makes an official report to the colony of Mauritius, spells its name with an "s" at the end. I am making a point of this difference in spelling for the sole reason that it happens to be the smallest of all the difficulties and discrepancies we are going to encounter. The more serious problems will come up later.

It is hard to say just who discovered these islands. There exists at least one old map on which the three islands have Arabic names. It is quite likely that Arab trading vessels did discover them, but without paying any special attention to their discovery, since the islands were uninhabited and it is exceedingly difficult to barter on uninhabited islands.

At any event, the Arabs did not even bother to locate the islands with any degree of care. On the map mentioned, they are drawn as forming an equilateral triangle and are placed far too close to Madagascar.

The first European discoverers were Portuguese but, strange to say, it was the second of the Portuguese discoverers who had his name attached to the islands.

The first one was Diogo Fernandes Pereira, who sailed these waters in 1507. On February 9th of that year, he found an island some 400 miles to the east of Madagascar which he named Santa Apollonia. It must have been the present Réunion. Soon after, his ship, the *Cerné,* sighted the present

Mauritius. The navigator landed and named the island after his ship, as Ilha do Cerne.

This, I might say right here, led to two different misunderstandings. Much later, around the middle of the nineteenth century, somebody who obviously did not know the name of Pereira's ship wondered why the navigator should have named the island after the island of Cerne, mentioned by Pliny the Elder. Wherever Pliny's Cerne was located, it could not be to the east of Madagascar.

The other misunderstanding took place quite soon after Pereira's voyage. Dutch explorers who came to Mauritius and knew the old name thought that Cerne was a miswriting for *cigne* (swan) and that Pereira had thought the dodos to be swans. The Dutch did not bother with the zoological problem involved; they "translated" Diogo Pereira's name into Dutch as *Zwaaneiland.*

Pereira, who was on his way to India, found Rodrigues later in the same year. It was first named Domingo Friz, but also Diego Rodriguez. The Dutch apparently found this hard to pronounce and talked about Diego Ruy's island, which then was Frenchified into Dygarroys—but the official French name for a time was Ile Marianne.

Six years later came the second discoverer, Pedro Mascarenhas, who visited only Mauritius and Réunion. No name change was involved for Mauritius because of this rediscovery, but Santa Apollonia (Réunion) was renamed Mascarenhas or Mascaregne, and to this day the islands are called the Mascarene Islands.

The subsequent history of the islands was just about as complicated as this beginning. Réunion, the largest of the three islands, 970 square miles in extent, was officially annexed to France in 1638 by a Captain Goubert from Dieppe.

I don't know why one annexation was not considered sufficient, but the historical fact is that the annexation was repeated in the name of Louis XIII in 1643 and once more in

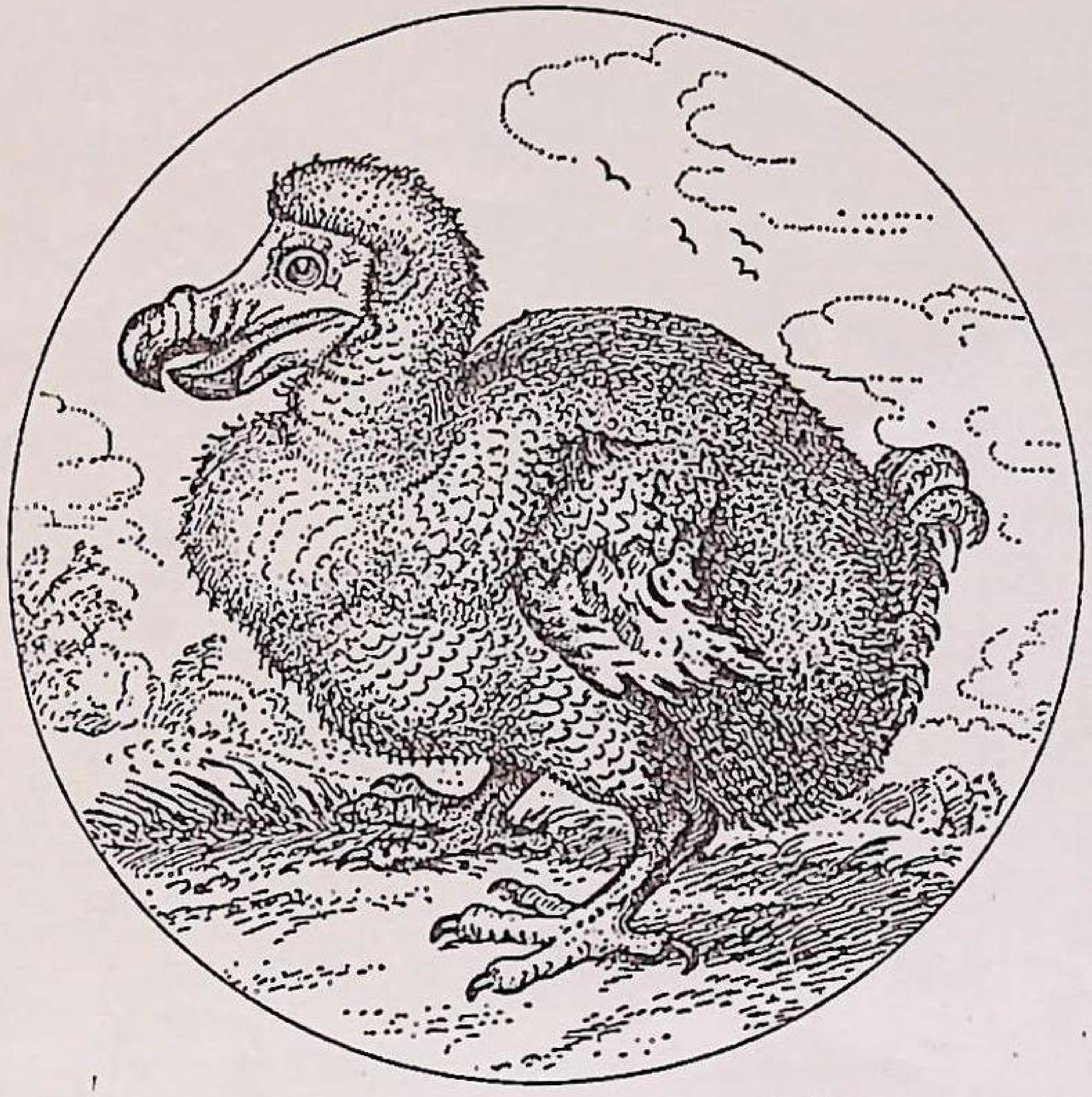

Fig. 27. The dodo of Mauritius as sketched by Adrian van de Venne in 1626.

1649 by Etienne de Flacourt, who changed the name from Mascarenhas to Ile Bourbon. After the French Revolution, that name had to go, of course, and Réunion was re-established. But then history can be read quite easily from the various changes, for it became Ile Bonaparte. Since 1848, it is again Réunion.

Considered non-politically, Réunion is a volcanic island with three rather tall peaks. The tallest is the Piton des

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Neiges, which measures 10,069 feet. The other high elevation is simply called Le Volcan by the inhabitants of the island, but Le Volcan has more than one peak. One, called Bory Crater, is 8,612 feet above sea level and extinct. The other crater, known as Fournaise, is only 8,294 feet tall but still active.

An island in such a location can grow tropical fruit and there are banana plantations and breadfruit trees, not to mention coconut palms. But these plants were introduced. The original vegetation included a dwarf bamboo, a variety of *casuarina* trees and a plant called by the trade name "red tacamahac," botanically *Calophyllum spurium.*

The second island, Mauritius, is somewhat smaller than Réunion (about 720 square miles) and likewise of volcanic origin. But all volcanic activity on Mauritius is a thing of the fairly distant past. The names of its three highest mountains reflect the changing ownership of the island through the centuries. The highest one, 2711 feet, is called Black River Mountain. The second one, 2685 feet, is Mt. Pieter Botte, while the third, 2650 feet, is called Pouce.

The island is surrounded by coral reefs which a ship's captain has to know well, but it has a fine natural harbor. These two features prompted the Dutch to annex it in 1598 and they gave it its current name after Count Maurits of Nassau.

The Dutch abandoned Mauritius in 1710. For slightly more than a half a century (1715-1767), it was French and called Ile de France. In 1810, it was taken by the English, who restored the Dutch name.

Right now, Mauritius is a "spice island" where spices, pineapple, mangoes, avocados and bananas are grown, along with sugar cane. But the original vegetation is still represented by ironwood trees, ebony trees, traveler's trees and bamboo. Of course, domesticated animals were introduced on both islands, but Mauritius is somewhat special even in that respect—the deer that can be found there came from Java, not from Europe.

As regards Rodriguez, its story is similar but shorter. Its extent is only 43 square miles. It is volcanic in origin, with 1300-foot Mt. Limon as its highest peak, and there is a fringing coral reef. The ownership of the island was Dutch, French and English in succession. In all cases, the first inhabitants were either deportees or people in voluntary exile, some of them mutineers, some refugees from religious intolerance.

Though all this had to be mentioned to establish a background, none of these facts would have made any of these islands famous. The only one which would enjoy a kind of restricted fame would be Mauritius, among stamp collectors, because of an early philatelic error which produced some of the rarest stamps in existence. But these Mascarene Islands are famous because they once were the home of the dodo and related birds.

The story of the dodo (let's concentrate on the Mauritius dodo for the time being) looks rather simple, if somewhat sad, in rough outline. Its existence was first reported by Dutch navigators, who were far less thorough in their descriptions than one would now wish they had been. But they made up for this to some extent by bringing live specimens back with them to Europe. There they were painted, mostly by Dutch painters and, again it must be said, not as well as one would now wish.

But the major blunder was committed in England. About 1637, give or take a year, a live Mauritius dodo arrived in England. It lived there for quite some time, and after its death, it was "stuffed" (badly, no doubt) and found a place in Tradescant's Museum in London in 1656. A few decades later, the stuffed dodo was transferred to the Ashmolean Museum at Oxford. This was in 1683—as we now know, two years after the last report of a live dodo on Mauritius was put on paper by one Benjamin Harry.

In 1755, the curator of the Ashmolean Museum decided that the moth-eaten old skin was a disgrace to his fine collection and ordered that it be thrown away to be burned with other trash. At the last moment, somebody wrenched off the head (partly decayed) and one foot (in good condition). They are now about the rarest items on record.

Even this outline story contains one more surprising item. The first scientist to include the dodo as an exotic bird in a book on natural history was Carolus Clusius in 1605. Later, Carolus Linnaeus gave it a scientific name, and quite naturally the dodo entered into the zoologicals works of Buffon in France and Blumenbach in Germany.

But by 1800, nobody had ever seen a dodo. The available paintings did not seem convincing. They looked like caricatures to begin with and did not even agree with each other.

Some scientists, bent on a housecleaning in scientific literature, began to doubt whether there had ever been such a bird. Maybe it was all a misunderstanding, if not worse, and the descriptions had meant the cassowary.

At any event J. S. Duncan of Oxford felt obliged, in 1828, to write a paper with the title: "A summary review of the authorities on which naturalists are justified in believing that the Dodo, *Raphus cucullatus* (*Didus ineptus*), was a bird existing in the Isle of France, or the neighbouring islands, until a recent period." Mr. Duncan can be said to have saved the dodo from secondary extinction in scientific literature.

But let's go back now to the original sources. The first man to write about the dodo was the Dutch Admiral Jacob Corneliszoon van Neck, who went to Mauritius with eight ships. Four of them returned to Holland in 1599, the other four in 1601. Admiral van Neck's narrative appeared in Dutch in 1601 and translations into English, French and Latin were

printed during the same year, a German translation one year later.

In spite of this volume of printed matter, there are still a number of question marks. The original journal, presumably written on shipboard, was enlarged for publication—we don't know whether by the admiral himself or by an editor. Moreover, one old naturalist, who did not leave Europe, gave a dodo picture which, he said, was copied from Admiral van Neck's journal. But this picture cannot be found in any known edition of the journal.

The passage in the admiral's journal in which the dodo is first mentioned reads:

> Blue parrots are very numerous there [referring to Mauritius] as well as other birds; among which are a kind, conspicuous for their size, larger than our swans, with huge heads only half covered with skin, as if clothed with a hood. These birds lack wings, in the place of which three or four blackish feathers protrude. The tail consists of a few soft incurved feathers which are ash-colored. These we used to call *Walghvogels* for the reason that the more and the longer they were cooked, the less soft and more insipid eating they became. Nevertheless, their belly and breast were of a pleasant flavor and easily masticated.

The Dutch word *Walghvogels* (also spelled *Walchvogels*) translates literally as "nauseating birds," but it led to one of the many mistakes that crowd the dodo's short life history.

About two hundred years later, it was asserted in German books that there had been Forest Birds, so named, on Mauritius. There probably were, and still are, forest birds on Mauritius, but the Forest Bird was only a sloppy translation, appearing in its German form of *Waldvogel*. Spelling in those days was helter-skelter in any language, so somebody probably thought that "walgh" was just a poor rendering of "Waldt," a then frequent spelling of the German word *Wald*, which means forest.

Since this has raised the problem of the name of the bird, it might be just as well to clear up this additional difficulty as much as possible.

In the most recent specialized professional work on the dodo, by the Marquis Masauji Hachisuka, not less than seventy-nine different names are listed. But the confusion is not quite as large as this figure seems to indicate, for the names clearly fall into a small number of classes.

One set of them tries to be descriptive. They are mostly French, as, for example, *austruche encapuchonné* (hooded ostrich), *cygne capuchonné* (hooded swan) and *dinde sauvage* (wild turkey). Another set are either translations or mistranslations of Dutch names. The Dutch names themselves are either variations on the theme of *walghvogels* or else descriptive terms similar to the French names just mentioned.

Just two words emerge as, so to speak, "exclusive" terms. One is the name *dodo*, with the variations *dodaars* and *dodaerts*, and the other one is *dronte*.

It is reasonably certain that "dodo" is a name coined by the Portuguese, as witness a letter written in 1628 by Emanuel Altham about "very strange fowles called by ye portingals Do Do."

The fact that Altham pulled the two syllables apart, thereby changing their pronunciation, is "very suspicious-making," as a French lady I know phrased it. It is so suspicious—or, rather, indicative—because old Dutch and German writings spell the name as *doedoe* and *dudu*, all of which must be pronounced "doodoo." Since it has no real meaning in *any* language, it can well be, as has been asserted, an imitation of the bird's call.

The Dutch variation *dod-aars* or *dod-aers* is rather clear to an English speaker, especially in view of the Dutch descriptive remarks *ende heeft een rond gat* ("and has a round rump," as van Neck put it) or *rond van stuiten* ("round of stern," as Capt. Willem van West-Zanen wrote in 1602).

However, the name dronte, which in Dutch and in German was used about equally frequently as dodo, still is not explained. The Englishman H. E. Strickland, who wrote the first book about the dodo in 1848, and it is still good, accepted the explanation that this term was coined by Danish sailors, using their verb *drunte*, which means "to be slow." This is not only somewhat far-fetched on the face of it, for the Danes, for a change, have not contributed anything to the story of this bird; it is not even necessarily correct. We simply don't know whether the dodo was slow and the evidence is not very much in favor of this assumption.

The Dutch zoologist Prof. A. C. Oudemans—yes, the man who wrote the 600-page book on the Sea Serpent—has pointed out—in another book devoted to the dodo only—that there was a now obsolete Middle-Dutch verb *dronten*. Its meaning was "bloated" or "swollen," which sounds much more reasonable. But Prof. Oudemans could not prove that this was actually the derivation; a lot of early writings on the dodo seem to be lost.

The records are incomplete also as regards the number of birds taken away alive. If it were not for a chance mention in Peter Mundy's journal—he served with the East India Company from 1628 to 1634—we would never know that two of them were brought to India. But his statement is definite: "Dodoes, a strange kind of fowle, twice as big as a Goose, that can neither flye nor swimm, being Cloven footed; I saw two of them in Suratt [the first British settlement in India, started 1612] house that were brought from thence [Mauritius]."

There is a similar chance mention about one having been sent to Japan, but Japanese scientists have failed, in spite of much effort, to trace its fate from Japanese chronicles and books.

Going by such remarks on the one hand and, on the other hand, by sketches and paintings stated or reported to have been made from life, Dr. Hachisuka listed a total of twelve specimens of the Mauritius dodo as having arrived in Europe: one in Italy, two in England and nine—five males and four females—in Holland.

In other books, particularly in works which treat the paintings as paintings instead of as ornithological illustrations, larger figures are usually mentioned. This is partly due to counting sketches and paintings made from earlier paintings. Mostly, however, it is due to the fact that no distinction is made between the gray Mauritius dodo and similar birds from the other two Mascarene Islands.

But no list, whether of specimens or of paintings, can be considered final. In 1914 and 1915, a German scientist, Dr. S. Killermann, set out on a systematic dodo hunt in museums, libraries and art galleries and discovered about half a dozen pictures that had simply been overlooked before. Killermann's feat could probably be repeated by somebody today with the inclination and the necessary time and money.

As has been mentioned, the Clusius picture has been copied from a lost original of van Neck's journal. Somebody might still find it. Similarly, it is known that an unnamed artist on board of one of the ships commanded by Admiral Wolphart Harmanszoon made several drawings from life while the ship was in Mauritius harbor in 1602. The originals are now "lost," but somebody might find them.

Likewise, one of the several oil paintings of dodos made by Roelandt Savery is listed as lost.

In short, while a dodo investigation is no longer virgin territory, it is still a fertile field with possibilities for a diligent researcher.

One of the earliest and best pictures of a Mauritius dodo drawn from life is the pen-and-ink drawing by Adrian van de Venne. It was made in 1626 and shows a male. This is what we now think of as the normal appearance of the dodo. However, it was Prof. Oudemans who first realized that the dodo must have had two "normal appearances"—one fat stage and one gaunt stage. This assumption explains many old sketches which look like caricatures; the latter impression is considerably strengthened by the fact that a number of sketches were made while the birds were moulting.

Oudemans' idea makes it possible to arrange all these sketches in a logical sequence, pre-moulting, at the height of the moult, post-moulting, fat and gaunt. But why a bird on a tropical island, where the food supply should be more or less the same all year round, should go through a gaunt stage at regular intervals is not yet fully explained.

The Mauritius dodo became extinct between 1681, the last time it is mentioned as living, and 1693, the first time it fails to appear on a list of the animals and birds of the island made on the spot. By 1750, the people living on the island did not even know any more that there had been such a bird.

A hundred years later, there lived a man on Mauritius who was an ardent naturalist. This man, George Clark, not only knew about the dodo, but was determined to find dodo remains. They had to be somewhere on the island, for the entire species could not possibly have become extinct without leaving traces. But where would these traces be located?

At first glance, the situation did not look too promising. "In fact," George Clark wrote, "there is no part of Mauritius where the soil is of such a nature as to render probable the accidental internment of substances thrown upon it. It may be classed under four heads: stiff clay; large masses of stone forming a chaotic surface; strata of melted lava, locally called *pavés*, impervious to everything; and loam, intermixed with fragments of vesicular basalt—the latter too numerous and too thickly scattered to allow anything to sink into the mass by the mere force of gravity. Besides this, the tropical rains, of which the violence is well known, sweep the surface of the earth in many places with a force sufficient to displace stones of several hundred pounds weight."

After having reached this point, Clark all of a sudden had a new idea. If these tropical rains swept everything before them, where did they sweep it? Well, there was a kind of delta formed by three rivers running into the harbor of Mahébourg. If dodo bones had been washed into one of the rivers, this was the likely place where they might have come to rest. One part of that delta was a marsh known locally as *le Mare aux Songes*. Mr. Clark promised himself that he would dig there, as soon as he had the time and some means to pay laborers for the actual work.

About 1863, he began to dig, finding large numbers of dodo bones at the very bottom of the marsh, to the delight of anatomists, and to the intense astonishment of aged Creoles who were standing around and were somewhat annoyed by seeing something on their own island which they had not known about. As a result of George Clark's successful digging, there is no doubt about the dodo's skeleton. As a matter of fact, it was this material which helped to unravel such problems as were posed by the sketches of artists who did not know anatomy—at any rate, not bird anatomy.

And while no museum can have an authentic dodo, several museums can, at least, boast authentic dodo skeletons, like the one at the Smithsonian Institution which was put together by Norman H. Boss.

The American Museum of Natural History in New York has such a skeleton, too, but it also has something which makes casual visitors wonder whether a dried skin might have survived somewhere.

The museum has a restoration, made in the taxidermy studios of Rowland Ward in London. The feet and the head are copied from the preserved specimens. The feathers are those of other birds, correct in color and, as far as can be ascertained, correct in shape. The dodo is in the fat stage, the one we know best from pictures.

Other Islands, Other Dodos

ABOUT 130 MILES OF OPEN SEA separate the two islands of Mauritius and Réunion. This is not a long distance for birds with a reasonable power of flight and it is only logical that many birds are common to both islands and even to Madagascar. For a flightless bird, however, 130 miles of open sea might as well be 3,000 miles—it could no more cross the one than the other. Hence it is obvious that the Mauritius dodo, of which Peter Mundy said specifically that it "can neither flye nor swimm," could not cross over to Réunion. Nor could a flightless bird of Réunion cross over to Mauritius.

Logically, then, if there also was a dodo on Réunion, it could not be expected to be the same as the dodo of Mauritius. Similar, yes, but only that. Their ancestors, presumably still capable of flight when they somehow got to the Mascarene islands, were no doubt the same. But even a short separation, as geologists speak of time, would produce very noticeable differences.

Well, there *was* a dodo on Réunion and it *did* differ from the Mauritius dodo, but for more than a hundred years, naturalists did their best to overlook this difference. Yet the very first witness pointed it out. He was an Englishman by the name of J. Tatton who, in 1625, published an account of a voyage made a dozen years earlier under Captain Castleton.

Reporting on Réunion, he wrote: "There is a store of Landfowl, both small and great, plentie of Doves, great Parrats, and such like; and a great fowl of the bigness of a Turkie, very fat, and so short-winged that they cannot flie, being white, and in a manner tame; and so are all other fowles, as having not been troubled or feared with shot."

The only other witness who saw the Réunion dodo on the island and wrote about it was the Dutch traveler Willem Ijsbrantszoon Bontekoe van Hoorn. He spent three weeks there in 1619, and not only described what is unmistakably a dodo, but even referred to it as a *Dad-eersen*. Unfortunately, he did not say anything about its color.

Later researchers, though, kept coming across pictures which did not jibe with the other dodo pictures. Not only was the plumage white with yellow wing feathers, but they were different in other respects, too. The feet were more slender, the tail was different and so was the bill.

Now it is true that there are sketches of the Mauritius dodo in which the bill looks different, the reason being that the moulting dodo also shed the sheath of the bill. But these white dodos seemed to have their sheath in place. The pictures are all by just two artists, Pieter Holsteyn (around 1640) and Pieter Withoos (around 1685). Since it is most unlikely that a full-grown specimen would live for forty-five years in captivity, this indicates that two specimens of the white dodo reached Europe.

The older naturalists failed to draw a clear distinction and even H. E. Strickland, in his monumental work on the dodo (1848), did not do so.

The white dodo was introduced to science as a distinct species as late as 1907, when the Hon. W. Rothschild published his work *Extinct Birds*. (It had the subtitle: "An attempt to unite in one Volume a short Account of those Birds which have become extinct in historical Times, etc.," but the short account turned out to be in folio with no less than 45 color plates.) The scientific name proposed for it was *Didus borbonicus*. In 1937, Dr. Hachisuka changed the scientific name (for various reasons that do not interest us here) to *Victoriornis imperialis*.

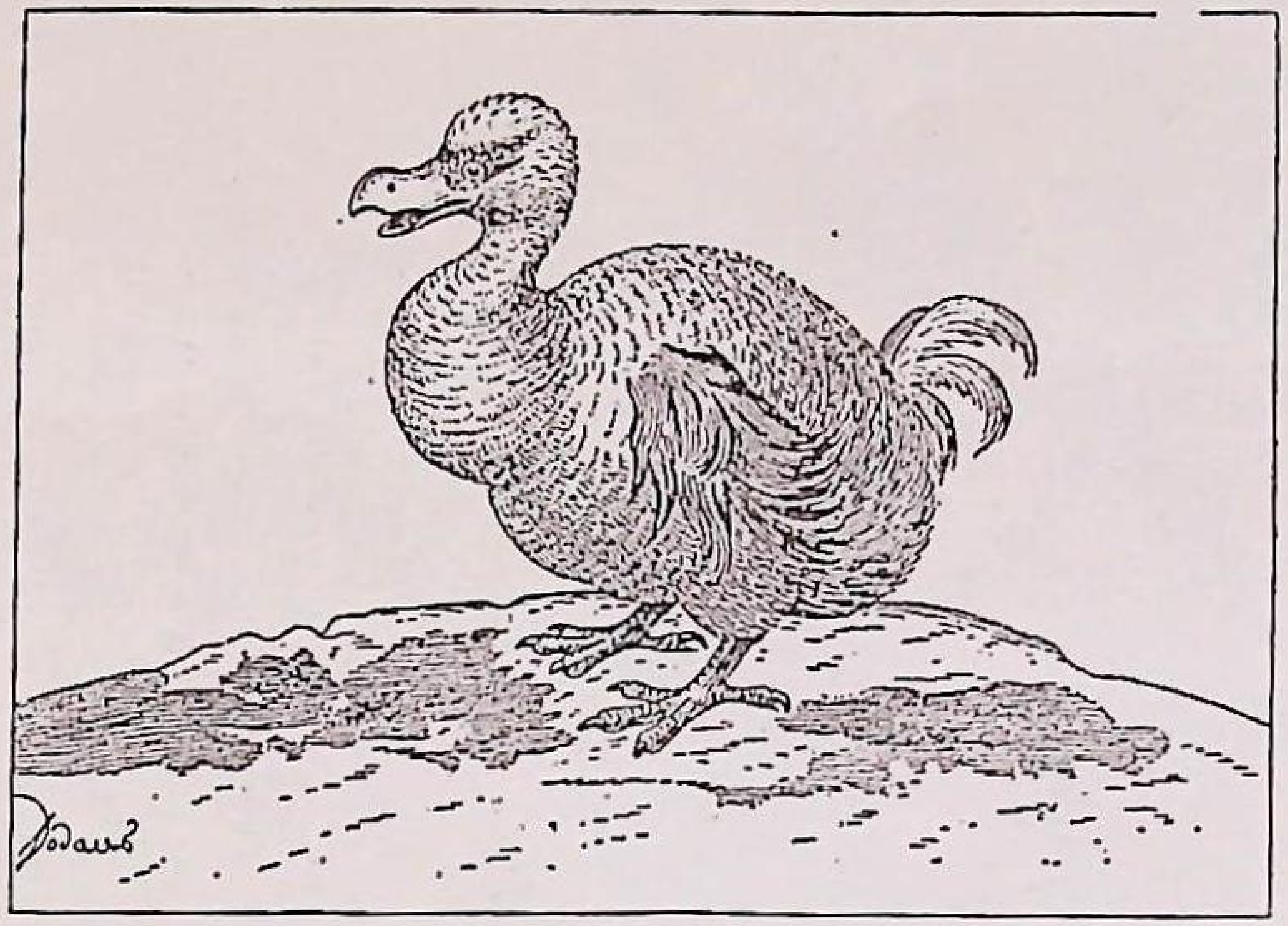

Fig. 28. Sketch of the White Dodo of Réunion, by Pieter Holsteyn, early seventeenth century.

Probably because Réunion is more mountainous than Mauritius, the white dodo lived longer than the gray dodo. There is a report that Mahé de la Bourdonnais, when he was governor of both islands, sent one to France. There is no record from the other end—we don't know whether it got to France or not—but Mahé de la Bourdonnais was governor from 1735-1746, long after the Mauritius dodo was extinct.

The Réunion dodo fails to be present for the first time in a survey made in 1801. It must have succumbed to dogs, rats and pigs during the latter half of the eighteenth century. That there was still something else to be said about Réunion was not even suspected until recently. But this additional mystery can best be explained with a detour to the third of the Mascarene islands, Rodriguez.

As has been told in the preceding issue, the island was first reached by the Portuguese Diogo Fernandes Pereira in 1507.

It took almost two centuries until settlers got there, and even these went to Rodriguez only as a second choice.

They were French Huguenots who were supposed to go to Réunion from Holland. It was a small group of only eleven men. Their chosen leader was a man a few years past fifty at the time whose name was François Leguat. His younger brother was also in the group.

The Dutch ship, with the French Protestants aboard, left Holland on September 4, 1690, and arrived at Réunion on April 3 of the following year. What happened then is not quite clear, but it seems that it had been believed in Holland that the French had abandoned the island. When the ship's captain realized that they had not, he did not land but set course for Rodriguez, where the French stayed for about two years. Then they built a boat and sailed for Mauritius.

A weird and senseless odyssey was the result of this act. About half a year after they had landed, they were discovered by the governor who, after a few months of deliberation, banished them to a small rocky island offshore. There they were kept prisoners for three years and then shipped, still as prisoners, to Batavia. A year later, they were released and sent back to Holland as free men, where they arrived in June, 1698.

François Leguat did not stay long, but went to England, where he rewrote the journal he had kept all along for publication. In 1708, both Leguat's French original and an English translation appeared.

Other voyagers had said before Leguat that there were "dodos" on Rodriguez, but Leguat was the first man who had lived there for any length of time. Moreover, Leguat could draw. He provided illustrations for his book and there can be little doubt that he had made the sketches on the spot, because some of them are rather complicated maps and plans.

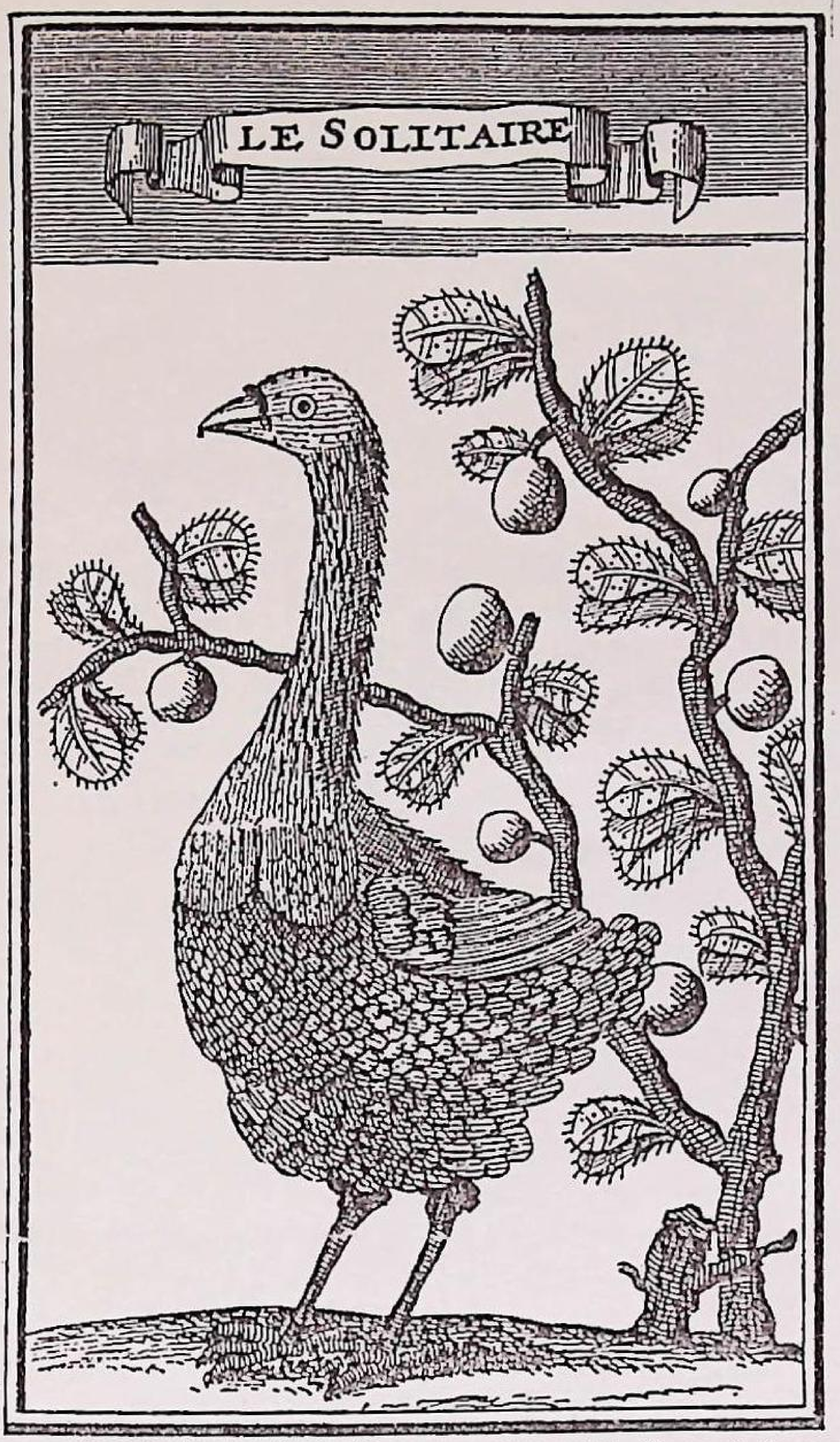

Fig. 29. The Solitaire of Rodriguez, as pictured in François Leguat's book of 1708. Drawing probably by Leguat himself.

"Of all the Birds in the Island," the English edition read, "the most remarkable is that which goes by the name of *Solitary*, tho' there are abundance of them. The Feathers of the Males are of a brown grey Colour: the Feet and Beak are like a Turkey's, but a little more crooked. They have scarce any Tail, but their Hindpart covered with Feathers is roundish, like the Crupper of a Horse; they are taller than Turkeys . . . The Bone of their Wing grows greater towards the Extremity, and forms a little round Mass under the Feathers, as big as a Musket Ball. That and its Beak are the chief Defence of this Bird. 'Tis very hard to catch it in the Woods, but easie in open Places, because we run faster than they . . . Some of the Males weigh forty-five Pounds."

Leguat reported that the males were brown in color, the females either brown "or fair, the colour of blonde hair"; most likely the brown ones were older females. He also mentioned that the females had a "head-band, like the head-band of Widows, high upon their Beak," and that lighter feathers on their chest formed an outline like the bosom of a woman. Leguat's drawing, therefore, is that of a female, since the males lacked these characteristics.

There is no other drawing of a solitary besides Leguat's. However, just as in the case of the Mauritius dodo, remains of the solitary have been excavated on Rodriguez, so that a few nearly complete skeletons could be constructed.

Again the story has a few wrinkles which were added later. In 1761, one of the famous transits of the planet Venus across the face of the Sun was due to take place and Rodriguez happened to be in such a geographical position that a fine observation of the transit could be made from there. The man to go to Rodriguez for this purpose was Abbé Pingré. In addition to doing the astronomical job for which he had taken the trip, Abbé Pingré reported that the solitaries were still around. He is the last man to have seen them.

Some five years later, Pingré's colleague and compatriot Le Monnier decided that the expedition should be honored in some manner. He had discovered a number of small stars in the space between the constellations Libra, Scorpio and Draco which could be put together into a new constellation. He was going to call it *Solitarius* to honor Pingré, Rodriguez and the transit of Venus expedition.

But he needed a picture of the solitary, and since his compatriot Brisson had recently published an enormous book on birds, he felt sure that it would be in there. Looking through the entries, he found a *solitaire* listed and copied the picture onto his star map. I don't know whether Le Monnier ever learned that the picture he used was that of *Turdus solitarius*, the solitary thrush!

The other wrinkle is tied up with the name of Geoffroy Atkinson, a professor of Romance literature who has written several books with titles like "The Extraordinary Voyage in French Literature before 1700," "The Extraordinary Voyage in French Literature, 1700 to 1720" and so forth. Personally, I failed to be enchanted by them; they are solid work, but I had the impression that Atkinson knew literature and nothing else.

Now I learn from Hachisuka that Atkinson, in 1921, went overboard with his interest in extraordinary voyages and declared that Leguat never traveled! He could "trace" every item in Leguat's journal to its "sources." The account of the Cape of Good Hope came from this book, the sea turtles from that book, the story of his imprisonment from still another book, the building of a boat from somebody else's memoirs.

One biologist who read this began to wonder. Leguat had said things about the anatomy of the solitary which were correct, as the skeletons proved, but which could not be found in any other book.

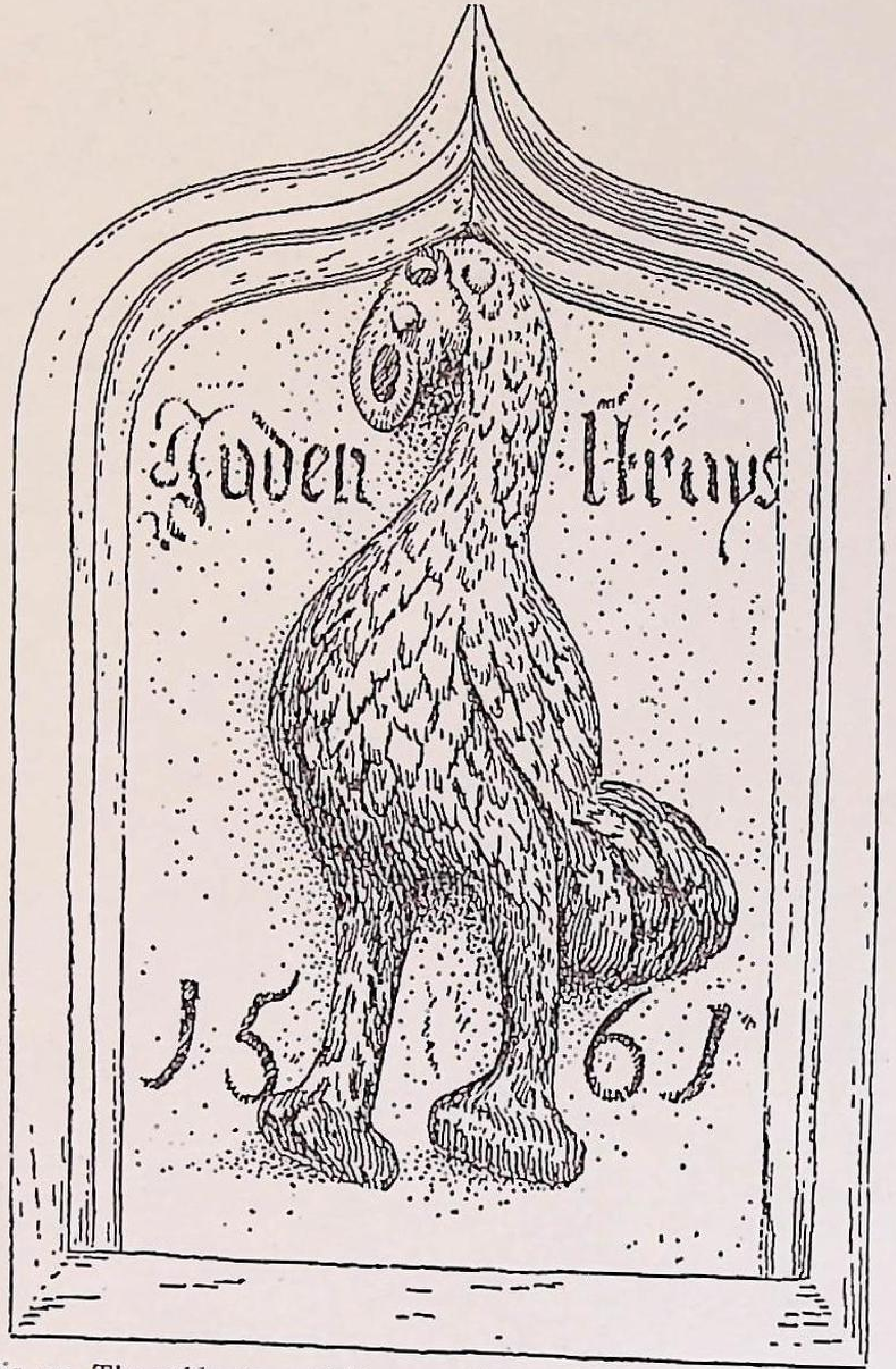

Fig. 30. The gable stone of Veere on Walcheren, discovered by Prof. Oudemans.

While the biologist was still brooding over the article, two French librarians very politely requested that Atkinson answer a few simple questions, to wit:

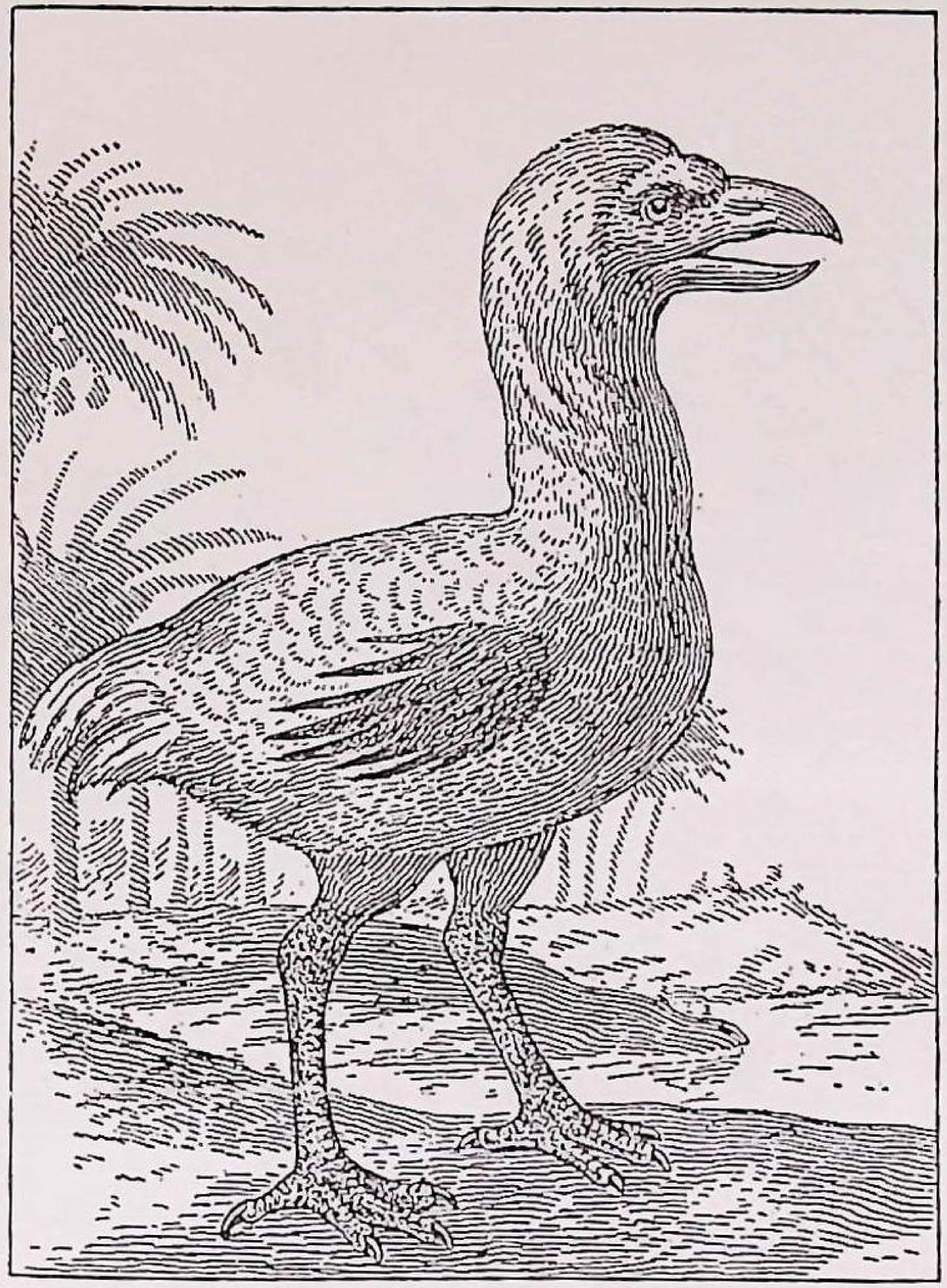

Fig. 31. Female Réunion solitaire, picture discovered by Dr. S. Killermann.

If Leguat had never rounded the Cape of Good Hope, why do the archives of Cape Town tell about the ship, its arrival, departure and so forth, all with the same dates as given by Leguat? Then, if Leguat never saw Rodriguez, why does the earliest map of the island (other than Leguat's own) name a few places after him? Why are there official reports from Mauritius telling of the arrival, imprisonment and deportation of refugees from Rodriguez? And, finally, why is there correspondence with the fleet commander about the trip to and return from Batavia?

Well, Atkinson did accomplish one thing. Before him, nobody had doubted the authenticity of Leguat's journal. Now we are sure that it cannot be doubted.

It remains to tell the scientific name of Leguat's solitary. It is *Pezophaps solitarius.* The first of these two names is put together from two Greek words: *pezós,* which means "pedestrian," and *phaps,* which means "pigeon."

Some readers who know something about the dodo's story may have wondered why I did not quote some of the well-known source material about the subject. For example, Sir Hamon L'Estrange's account in his memoirs:

> About 1638, as I walked London streets, I saw the picture of a strange fowle hong out upon a cloth and myselfe with one or two more then in company went in to see it. It was kept in a chamber, and was a great fowle somewhat bigger than the largest Turky Cock, and so legged and footed, but stouter and thicker and of a more erect shape, coloured before like the breast of a young cock fesan, and on the back of dunn or deare colour. The keeper called it a Dodo, and in the ende of a chymney in the chamber there lay a heape of large pebble stones, whereof hee gave it many in our sight, some as big as nutmegs and the keeper told us that she eats them (conducing to digestion), and though I remember not how far the keeper was questioned therein, yet I am confident that afterwards shee cast them all again.

My reason for not bringing this up earlier is that this statement almost certainly does *not* refer to the dodo, even though

the keeper called the bird by that name. The coloration does not fit the gray Mauritius dodo and certainly not the white Réunion dodo. Nor does the "more erect shape" as compared to the turkey.

As Dr. Hachisuka points out emphatically, this is a description of a bird of the type of the solitary, not of the dodo type. It must have been the use of the name dodo which made earlier researchers accept Sir Hamon's account as one of the dodo and to surmise that this was the specimen which later was in Tradescant's Museum and finally thrown away.

There have always been some descriptions of a bird from Réunion which did not quite "fit."

There was the narrative of a Frenchman named Carré who went to Réunion in 1668: "I saw a kind of bird in this place which I have not found elsewhere: it is that which the inhabitants call the *Oiseau Solitaire,* for, to be sure, it loves solitude and only frequents the most secluded places; one never sees two or more together; it is always alone. It is not unlike a turkey, if it did not have longer legs."

Another very similar description came from the Sieur DuBois who arrived in Réunion in 1669. He listed the birds he saw, and when he came to *Solitaires,* he stated: "These birds are so called because they always go alone. They are as big as a large goose and have white plumage with the tips of the wings and tail black. The tail feathers are like those of an ostrich, they have a long neck, and the beak is like that of the Woodcock, but larger; the legs and feet are like those of a turkey."

Carré's and especially DuBois' statements led Strickland to suspect that maybe Réunion had both a dodo and a solitary.

Rothschild, after weighing all the evidence, also said that there must have been two different birds on Réunion, either two kinds of dodos which were quite far apart in appearance, or else one dodo and one solitary resembling the Rodriguez type.

A. C. Oudemans, ten years after Rothschild, took the position that all this was a mistake. The men who reported on them probably were not too observant as regards the moulting stages of the birds. Oudemans' main argument is that nobody described both birds, so to speak, side by side.

This is admittedly sad, yet it so happens that nobody did. But if you read what reports there are, you get the impression that the bird called *solitaire* seems to have been quite numerous, while the white dodo obviously was not. Moreover, Réunion is large enough so that the two birds could have had different habitats.

Somewhat ironically, Prof. Oudemans himself produced evidence for a solitary in addition to the one on Rodriguez.

During the First World War, Prof. Oudemans, vacationing with his wife, looked at the gable stone of a house in Veere, on the island of Walcheren. The stone said that the bird pictured was an ostrich. It also clearly gave the date: 1561. Oudemans did not need long to see that the bird, whatever it was, was not an ostrich. But it could be a dodo. If so, this was the earliest dodo picture on record.

The picture is reproduced here. Prof. Oudemans sent me a print in 1936 when we had correspondence mostly about the Loch Ness animal.

It must be a gaunt dodo, Oudemans felt, for it certainly could not be a Rodriguez solitary. Leguat had been very specific about its being tailless with a round feather-covered rear end. Look at the tail feathers, Oudemans wrote. Almost like those of an *Afrikaansch struys* (African ostrich) or like those of a dodo.

Well, the answer is that it was not a Rodriguez solitary but a Réunion solitary (now called *Ornithaptera solitaria*) and the tail feathers, so prominent on the old Dutch gable stone, are just as prominent in the so-called dodo of Florence, one of the pictures discovered by Dr. S. Killermann. This picture is now taken to portray a male Réunion, while another picture, also discovered by Killermann, shows a female. Comparing this picture with the one of a Rodriguez female by Leguat, one can see how the two birds resembled each other and in what respects they differed.

There is one more picture of the same bird (not reproduced here) which is now at McGill University in Montreal. It is of Italian origin, being picture No. 29 in the so-called "Feather Book" made by Dionisio Minaggio in Milan in 1618. It consists of 156 large pictures with birds, practically all of them hunting scenes.

The interesting point is that the birds are never painted. The real beaks, feet and feathers of birds have been used. Unhappily, the picture of the Réunion solitary is "faked." That is to say that legs and beak have been painted and that the feathers used for the body are those of other birds. But it is undoubtedly the same bird as a dodo of Florence.

That attempts to ship Réunion solitaries to Europe were made is stated by Carré, who says that two of them were caught to be sent to the king (of France) but aboard ship they died of "melancholy." In a few other cases, shipment must have been successful. The 1561 stone masonry in Holland must have had a model. One male must have arrived in Italy around 1618. We do know that there was one on exhibit in London around 1638 and there is evidence that a female got to Vienna in or about 1657.

The story has a postscript called the dodo of Nazareth or, more learnedly, *Didus nazarenus*.

I thought the case had been nicely cleared up by Iosif Kristianovitch Hamel of the Russian Imperial Academy of Science in St. Petersburg, which published a fairly long study in its Bulletin of the Physical-Mathematical Section in 1848.

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Professor Hamel, after reading all the sources, had found a convincing piece of evidence. You remember that the Dutch called the dodos *Walghvogels* or "nauseating birds" because their taste was so atrocious. (One of them declared firmly that the dodo was for wonder, not for food.) The French had translated *Walghvogels* correctly into *oiseaux de nausée.* But one François Cauche, who spent two weeks on Mauritius in 1638, wrote about the dodos *nous les appellions oiseaux de Nazaret.*

Cauche probably did not try to taste dodo and did not see why the birds should be nauseating, so he thought that the word *nausée* was actually *Nazaret,* which sounds somewhat similar in French. And there was a place called Nazareth nearby on a nautical chart. There still is, but it is now labeled a "bank" while on earlier charts there is an island by that name. Professor Hamel thought this was a simple mistake.

He may be right. But when Prof. Oudemans checked old charts systematically, he found a few in which the name of Nazareth is not placed next to an island where we know that there is no island, but near the existing, if tiny, island which on modern charts appears as Ile Tromelin.

Nobody knows much about Ile Tromelin. It cannot be of any importance because the latest edition of the Admiralty Charts states that its position may be five miles off on the map. If it were of any importance, this would surely have been ascertained by now. Maybe the mapmakers who produced the old charts seen by Oudemans simply lettered Nazareth next to it because there was supposed to be such a place and it was the only island left in the whole area, the other suspected islands having turned into banks and shoals.

But Oudemans said that *Didus nazarenus* cannot be dismissed completely until Ile Tromelin has been carefully investigated. Not that he expected to find live dodos of any kind; he meant subfossil remains like those found on Mauritius and on Rodriguez.

In principle, Oudemans is naturally correct; as long as there is an uninvestigated lead left, the book should not be closed.

No such investigation has taken place. But until it is and the facts prove otherwise, I prefer to accept Prof. Hamel's explanation.

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10

The Last of the Moas

I HAVE THE FAINT FEELING that the word "moa" would be far less known than it is if it were not such a useful word for crossword-puzzle purposes. No statistics are available—as so often happens in the case of cultural items of probably undisputed value—but I would guess that a diligent researcher could turn up a different crossword puzzle for every day in the year which shows three spaces to be filled in with something defined as "extinct bird."

To the naturalist, the three letters M-O-A spell something else again—it might as well be D.O.A. Exploring and literate men got to New Zealand too late to see the moas, just as they have been too late in quite a number of other places. To make the whole story more lamentable, exploring seamen occasionally did get to such interesting places in time.

But they did not know what to look for, from our point of view. Maybe they simply missed what we would consider interesting. In some cases, one may suspect that they merely failed to write down what they saw. At any event, a modern naturalist, transported back to earlier but still historical times by time machine, could seize on various lost opportunities.

He would have joined the Phoenician sailors, for example, who set out in 596 B.C. to round Africa at the request of Pharaoh Nekho (or Niku) and who actually succeeded in doing it during the two years that followed. We don't know whether they passed through the channel separating Madagascar from the African mainland or whether they sailed "outside" of Madagascar. We do know that they made numerous landings; one of them may have been on Madagascar. If a modern naturalist had been along, he would have made sure of such a landing in order to look for the near-fabulous *Aepyornis,* the enormous ostrichlike extinct bird of that island.

We don't really know how it looked. Of course we can reconstruct its skeleton; in fact, we have. But we have no idea of its plumage. All we know is that it has not been extinct for very long. The Phoenicians of that trip would surely have found it; even the Crusaders might still have been in time.

A modern naturalist would also accompany the Arabs who at a reasonably early time sailed the Indian Ocean and did go as far east as Sumatra and Borneo. The modern naturalist would have talked the shipmaster into turning due south there to get to the Australian shore. Presumably he would have been in time to see the now extinct giant marsupials of Australia, colossi as large as the strongest bull. They were no longer among those present when Australia was actually discovered.

Such a naturalist might even have seen the *Megalania,* indubitably preferring a safe shelter if this occasion came up. The *Megalania* was a monitor lizard of which the following things are certain: it was enormous in size and did not become extinct until fairly recent times.

As to its size, learned opinions differ—some scientists felt that the animal might have been more than thirty feet long; others gave it only twenty feet.

The date of its extinction is equally uncertain. Anthropologists have concluded from native legends (which may or may not refer to this monitor) that the *Megalania* was still alive less than a thousand years ago. But the remains actually found by naturalists look older than that.

The last item in this condensed list of missed opportunities is that our naturalist should have been aboard the good ship *Heemskirk* when its captain, Abel Janszoon Tasman, saw high mountains rise from the sea on December 16, 1642. This date marks the discovery of New Zealand. The modern naturalist would have made Tasman land instead of just sailing on. He then would certainly have been able to show Tasman a few moas.

Like the *Aepyornis* of Madagascar, the moas were ostrich-like birds, many of them very large. But there were also smaller varieties. They were distributed over the three islands which comprise New Zealand, the two large ones which are now called North Island and South Island, and small Stewart Island to the south of South Island. The qualifying statement "now called" was necessary because on some old maps you can find the present Stewart Island labeled as South Island. On these maps, the present South Island logically appears under the name of Middle Island.

We know the moas mostly from their bones that have been found in all three islands. In addition to the bones, a few feathers are known and quite a large number of eggshells that could be restored. Naturally we cannot tell which eggs belonged to which bird, for comparative size is no guide. The still living New Zealand kiwi, though probably not a direct relative of the moas, is at least of the same general type, and it throws any guesswork into the wastepaper basket. The kiwi, a smallish bird, lays an egg which is far larger, by comparison, than that of the African ostrich. On the other hand, the eggs of the cassowary are smaller than one would expect.

Footprints are known, too, of both the larger and the smaller species. The small ones show a stride of not quite 20 inches, while the large ones show a stride of over 30 inches. The large ones look surprisingly like some dinosaur footprints of much greater age. In the case of the footprints as well as of the length of the stride, there is a definite correlation between size of print and length of stride and the size of the bird. For this reason, at least some of the footprints can be tentatively ascribed to a species.

The moas of the past are now subdivided into five different genera, each with several species. It should be said at the outset that some of the species are doubtful, since they are based on only a few remains. It is quite possible that we have a few more species in our catalogues than existed in reality; it has happened with other extinct animals that male and female were classified as two different species if they differed considerably. However, the following is the tentative list of the moas, by genera:

Dinornis. The moas belonging to this genus were the tallest of the lot, their heads towering more than 12 feet above the ground. Largest of the six species was *Dinornis maximus*. All species were rather light-boned.

Euryapteryx. The moas of this genus were squat and heavy but not very tall, their heads being five to six feet above the ground. They must have been very numerous at certain times. There are five recognized species; a sixth is uncertain.

Megalapteryx. Two species from the South Island only. These were large for birds but small for moas, being not much over three feet tall. As the name of the genus indicates (from Greek *megas*, meaning large, and *apteryx*, the scientific name of the kiwi), they might also be taken for giant kiwis.

Emeus. Three recognized species with a fourth one uncertain, standing about four feet tall.

Anomalapteryx. Five species, most of them very early and rather small, of about the size of the *Megalapteryx* moas. One of these five species grew seven feet tall; it is also the most recent of this genus.

This list of genera, comprising just short of two dozen species, must not be misunderstood. At no time could one have found all twenty-two species alive on the islands. The best one could have expected would have been ten or eleven species alive simultaneously. Unfortunately, we cannot say what time that would have been. The era of the Homeric heroes—1000 B.C.—seems like a good guess.

By now, I have told what is really known about the moas; everything else is either unknown, or uncertain, or at least disputed.

Even the story of how the moas became known to science is rather complicated. The first explorer to land on New Zealand and to talk to the Maori living there was Captain James Cook, during his visit in November 1769. With the aid of interpreters who seem to have been of doubtful value, Captain Cook spoke to the Maori chieftain Tawaihura and asked him, among other things, about the animals occurring on the island.

Chief Tawaihura told the captain about a large and dangerous lizard—which must have been purely mythological, since no really large lizard does or did exist on New Zealand—but did not say a word about large birds. We can be rather certain now that there were no moas in the area where Tawaihura lived, even though they may still have existed elsewhere. With great fire and lack of logic, some scientists have made much of this omission, taking the negative evidence of Captain Cook's journals as positive proof that the moas became extinct at a much earlier date.

Beginning about the year 1800, people began to visit New Zealand and write books about their travels. Strangely enough, none of the first six books written on New Zealand (or about New Zealand) even mentions the moas. The first book to mention them does not use the name; it is a narrative that was published in London in 1838. Its writer was a trader by the name of Joel S. Polack and it is merely one more kink in the story that a missionary who knew Polack swore that Polack could not write.

Well, the book with Polack's name on it exists; the New York Public Library at Fifth Avenue and 42nd Street has a

copy of it and I have read it myself. I cannot imagine that a trader can pursue his business and presumably make a profit without being able to write, but it might easily be that trader Polack did not write English and that the printed book is a translation of a manuscript in another language. At any event, trader Polack relates that he was shown very large bones and adds that the animals these bones came from were alive on the South Island. But he did not make clear what made him say so. Did the Maori tell him? Or did he draw this conclusion himself?

At about the time trader Polack was there, a Reverend William Colenso began hearing stories about gigantic birds from natives, and another missionary, the Reverend William Williams, started collecting moa bones.

The first moa relic to be placed into scientific hands was a large leg bone with both ends broken off. The year was 1839 and the hands which received this bone were very competent indeed, belonging to Professor Richard Owen, of London. They also happened to be reluctant hands—Professor Owen actually took it to be a soup bone at first glance. Even the simple fact that Owen received this bone has been embroidered nearly out of recognition. A story has it that "an illiterate sailor" left the bone for Owen when the professor was not at home.

Well, the man who took it there, and Owen was at home, was a sailor all right, but far from illiterate. He was the surgeon Dr. John Rule who had specifically traveled to England with the bone to see Professor Owen. When Owen was unimpressed, Rule persuaded him to devote more time to it.

Owen first "tried" the bone in the museum by holding it against the skeleton of a cow. It did not "fit." Owen tried the skeleton of a horse next. Finally, having run out of large mammals, he held it next to the leg of an ostrich skeleton. This was it! The bone matched that of the ostrich, except for size.

Once Owen was convinced, nothing could hold him back.

His colleagues, though admitting that it seemed to belong to a bird, suggested that he wait until more and undamaged bones became available. But Owen would have none of it. He knew that this was a bird bone, having belonged to a bird of the general build of an ostrich, but bigger and more massive by far. And since the bone was not fossil, the bird could not be dead for very long.

Thus Owen prepared a scientific report. It could not be very long, but what there was of it was very positive. Moreover, Owen reasoned, a layman does not know what to look for unless a scientist tells him. So he ordered the printing of 500 extra copies of his short report, to be distributed in New Zealand among missionaries, shipping agents and settlers. The 500 copies were crated for shipment to New Zealand to serve as a call for more evidence. But before the crate with the pamphlets had even crossed the equator, another crate arrived in London. It was full of moa bones, the bones collected by the Reverend Williams.

There was, it is reported, some ludicrous trouble with the Royal customs inspectors who found some kind of rule against the importing of bones. Fighting, so to speak, the British Museum and the Royal Society, not to mention Owen himself, the ones who lost were the customs inspectors. The final outcome of it all was a magnificent report by Professor Richard Owen.

A few years later, an interesting story came from New Zealand. Governor FitzRoy had met an old Maori chieftain by the name of Haumatangi. The year was 1844 and Haumatangi was about 85 years old. The old man told the governor proudly that he remembered seeing Captain Cook. Since the visit referred to was the one of November 1773, Haumatangi must have been about 14 at the time, so the claim sounded credible. Haumatangi added that the last moa in his province had been seen two years before Captain Cook's visit. This statement, of course, had to be taken on face value.

Another story which was circulated a little later had it that another chieftain, Kawana Paipai, said he had taken part in a moa hunt when he was a boy. The date figured out to be 1798 or 1799. Two or three other Maori, questioned around the middle of the last century about moas, declared that their grandfathers had told them about moa hunts. These dates all worked out to about 1770. It looked, therefore, as if the last moas were hunted to death around 1800.

In New Zealand itself, scientific opinions began to be sharply divided, the battle cry being, strangely enough, "the men of The Fleet" who did, or did not, find islands populated with moas. It has to be explained here that the Maori had come from islands near Tahiti in several waves of immigration. The main (and latest) wave is called The Fleet and the generally accepted date is "around 1350 A.D."

One school of thought—which became the minority party—had it that the Maori of The Fleet began to kill the moas for food and that the process of extermination was complete in Captain Cook's time. Another school of thought, however, claimed that the men of The Fleet arrived just about in time to see the last of the moas die.

It has to be said that everything written and printed about the moas in New Zealand for several decades was not written to establish facts, but to defend either the one or the other school of thought.

The ones who said the moas had died out very early had quite a number of ingenious arguments.

So-and-so-many Maori (say during the period from 1840 to 1860) did not know that moa bones had belonged to birds when they were shown them.

The word "moa" itself was used to mean "stone" or a raised small piece of land, like a flower bed.

There were only a very few proverbs and sayings in which the moas figured; they were usually figures of speech like "gone like the moa." These proverbs seemed to be centuries old.

As regards the statement that "my grandfather said that he hunted moas," it was pointed out that the words "grandfather" and "ancestor" are the same in the Maori language. As for old Haumatangi, he had probably just embellished on his memories of long ago hearing folk legends.

And Kawana Paipai was disposed of in two ways. One was that he also told about battles which were obviously invented. The other was that he had never made his statement about the moa hunt; the point being that there were at least three white witnesses to the statement and only one of them repeated it later.

In the meantime, places where moas had been slaughtered and cooked were found. There could be absolutely no doubt that humans and moas had lived together at one time. The problem was to say when.

Some scientists assumed a different native population, not only pre-Fleet but pre-Maori, which must have been the moa hunters. Other scientists said that the moa-hunter period did not have to be any other culture than Maori; they had been Maori of an earlier cultural level. This idea was contradicted mostly by the Maori themselves, who refused to believe that their ancestors should ever have changed, and who imagined the sailors of The Fleet to have been precisely like their fathers and grandfathers of about 1800. This, of course, just wasn't so—the Maori, like all peoples, changed considerably through the centuries.

Actually, everybody seems to be right depending on where you look. A number of moa-hunter campsites are indubitably Maori. Some others are almost certainly not Maori—of any cultural level. There seem to have been earlier castaways who settled on New Zealand and who did not come as organized immigrants like the Maori of The Fleet.

A fairly new scientific tool has been brought into play with some hopes of deciding the endless battle about the time of the moa hunters and, if possible, of the last of the moas. This tool is radio-carbon dating, or the C-14 method, which can tell the age of many things by their amount of carbon-14.

There are just two requirements. The first is that whatever it is that must be dated must once have been alive, bone or wood or even charcoal, for non-living things do not take up carbon-14 from the atmosphere. The second is that the object must not be older than 25,000 years or thereabouts; after that time, the carbon-14 is gone and the age becomes uncertain, except that it clearly is more than 25,000 years. Another aspect of the C-14 method is, unfortunately, that the object to be dated is destroyed in the process, so that scientists are rather handicapped when it comes to valuable specimens.

One *Dinornis* specimen was found in a freshwater deposit with its crop reasonably intact. And the crop was still full of food (plants) which could be sacrificed for dating. The result—these plants were eaten by the bird about 670 years ago or about 1300 A.D. To some, this was a surprisingly late date for *Dinornis,* because they had assumed that even the pre-Fleet Maori only knew the heavy *Euryapteryx* type.

The argument of whether the moa hunters were pre-Maori people, pre-Fleet Maori or just Maori after The Fleet must not be taken to mean that the extinction of the moas is placed squarely on the shoulders of the moa hunters, whoever they were.

Even if nobody had ever come to New Zealand prior to Captain Cook, the moas would probably be rare birds by now. They were completely flightless, they probably bred slowly, and they were most exceptionally stupid, for the brain of a six-foot moa was the same size as that of a turkey. Many moas died in swamps, indicating they probably could not swim. On the North Island, many perished at one time because of forest fires set by volcanic eruptions. There is some

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evidence of disease among the moas. But the main reason their numbers declined seems to have been a fairly small climatic change which diminished the open plains and increased the forest and swamp areas.

The moas were obviously on the downgrade for natural reasons. The moa hunters merely helped along and may have provided the final touch in the demise of the moa. But when was that?

Nobody will commit himself.

The proof that even the tall *Dinornis* type was still active and alive at the time of The Fleet has been rather a blow to some of the archeologists of New Zealand. In the course of time, the party which had proclaimed a very early date for the last of the moas had succeeded in attaining the position of "the voice of science." What they said was "science" and what the others had said was either amateurish, or just the spirit of the nineteenth century, or else a wrong conclusion due to lack of evidence that has become known since—the phrasing depended to some extent on whose opinion was being demolished.

In one point, however, even the most conservative wing of the New Zealand scientists was rather lenient. It was admitted that small moas of the *Megalapteryx* type may have survived until quite recent times on the South Island. Roger Duff, the Director of the Canterbury Museum in New Zealand (and one of those "shocked" by the outcome of the carbon-14 dating), dates two Maori-made artifacts using moa skin and moa feathers as from the seventeenth and eighteenth centuries respectively. Roger Duff's dating, incidentally, is based entirely on archeological and ethnological evidence.

Zoologists seem to feel that something must be wrong, even though they can't say what or why.

The simple fact is that some of the moa remains do not look as old as the archeologists say they must be. And New Zealand is not a place with a dry climate which tends to preserve animal remains indefinitely.

It is interesting that the most recent story of a moa hunt came from the South Island, in fact from the southwestern end of the South Island where the *Takahe*—scientific name *Notornis*—was finally discovered alive after having been thought extinct.

That story takes up just one part of one paragraph in Vol. II of Sir Walter Lawry Buller's *History of the Birds of New Zealand*, published in London in 1888. The sentence reads: "Sir George Grey tells me that in 1868 he was at Preservation Inlet and saw a party of natives there who gave him a circumstantial account of the recent killing of a small Moa, describing with much spirit its capture out of a drove of six or seven."

That's all, but it might be prudent to say that Sir George Grey had been, in succession, governor of South Australia, twice governor of New Zealand and then governor of the Cape Colony—in short, not somebody you would expect to make up tales.

It is true that there has been no report since then, at least not one that could be called definite. But there still *are* virtually unknown areas on the South Island. Maybe the last of the moas, even if a small type, is still somewhere around. I don't assert that this must be the case. But there is also no reason for stating categorically that the final chapter has been written.

ANOTHER LOOK AT ATLANTIS - and fifteen other essays by Willy Ley
1969
Doubleday & Company , Inc.,
Garden City , New York

invitation, to have tea with a local landowner named Li, and in Li's house he saw a black and white pelt. The animal was not a bear, however; it was what we now call the Giant Panda.* Its scientific name is *Ailuropoda melanoleucus*. The first part of the name really means "cat-footed" but is meant to indicate the relationship to *Ailurus*, the Lesser Panda. The specific name is composed of the Greek words for black and white.

The next discovery of a large, living, and up to then unknown, animal came about ten years later. The discoverer was a Russian cavalry officer of Polish descent, Nikolai Mikhailovitch Przevalski, and the animal was the Asiatic wild horse; its scientific name is *Equus przevalskii*. Specimens are kept in many zoological gardens and it breeds well in captivity. Quite recently (1966) it was found to be able to crossbreed with the domesticated horse.

But the discovery that really caused a stir in the scientific world was made in Africa in 1900. This was the short-necked giraffe okapi. Officially its discoverer was Sir Harry Johnston, but Johnston said that Sir Henry Stanley should receive the credit. Stanley, a year or two prior to 1890 (the year in which his book *In Darkest Africa* was published) had learned about an unknown animal which the Wambutti pygmies called *atti*. From a discussion with Stanley which took place after the animal had been scientifically described, Johnston concluded that Stanley had actually seen okapis without realizing that they were new to science.

The circumstance that is considered the actual discovery was Johnston's obtaining two strips of okapi skin from Belgian officials in the Congo. The Belgians told him that the animal was called "okhapi" by the natives, that it had a "drawn-out" muzzle, and that one had been killed recently. The skin was around and if Sir Harry wanted it, he could have it. But meanwhile native soldiers had cut up the skin for belts and bandoliers, and only two strips with zebralike markings could be found. These were sent to London. Johnston thought that the animal was an unknown species of zebra and Professor E. Ray Lankaster of the British Museum agreed tentatively, naming the animal *Equus (?) johnstoni*. The doubt expressed by the question mark was due mainly to the repeated mention of forests in descriptions of the animal; zebras avoid forests and prefer the open plain. In June 1901 Professor Lankaster could be pleased about his doubts. A complete skin and two skulls arrived in London, showing that the animal was not a zebra. The name then became *Okapia johnstoni*.

In the wake of the discovery of the okapi, European naturalists and animal dealers received a fairly steady stream of reports of other still unknown animals in Central Africa. Some of these reports sounded like fantasy, others were indubitably plain mistakes, but one was persistent. It referred to a wild hog of unusual size, and while the descriptions did not always tally they all agreed on the color: black. There also was one piece of evidence for this hog—a skull from the "Pepper Coast" that had been described by the American physician Dr. Samuel G. Morton in 1844 and had been given the name *Choeropsis*. The reports from Africa had also mentioned a native name for the wild hog; it was *nigbve*. Was the *nigbve* the same as Morton's *Choeropsis?*

The question seemed to be settled in 1904 when a Captain Meinertzhagen of The King's East African Rifles obtained a perfect skull of a black hog from a native and a somewhat damaged skin of another specimen from another native. The existence of an exceptionally large black hog was now an established fact and the animal was named *Hylochoerus meinertzhageni*. There was only one discrepancy. Captain Meinertzhagen's black hog had been killed in the Ituri forest while the rumors of the *nigbve* came from the west coast of Africa, centering more or less on Liberia. Moreover, the two skulls were so different that a small child, if shown pictures, would have seen that they did not belong to the same animal.

Meinertzhagen's discovery had been, so to speak, a side issue. Dr. Morton's *Choeropsis* was something else, possibly identical with the *nigbve* of the African natives but possibly extinct. Carl Hagenbeck, the animal dealer who ran his own zoological garden near Hamburg, heard more and more stories that made him believe that either *Choeropsis* or *nigbve* (if they were not the same animal) was not extinct and he finally decided to send Hans Schomburgk on a one-man expedition to Liberia. The local people in Monrovia, black and white alike, considered this a useless quest. But Schomburgk did not give up easily and on June 13, 1911 he saw a *nigbve* in the open. The onset of the rainy season prevented further exploration during that year, but in February 1913 Schomburgk was back on the scene. He shot a *nigbve* one day and captured another one alive the next day. The case was clear. *Choeropsis* and *nigbve* were the same and obviously the animal was not extinct. But it was not a hog either, but a fairly distant relative of the hippopotamus; it is now popularly known as the "pygmy hippo."

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* The name panda is said to be a contraction of the native name *niyalya ponga*, which is supposed to mean "bamboo eater." I don't know whether the translation is correct, but the pandas are bamboo eaters.

There were more rumors about unknown African animals but the next one that was discovered had not been rumored, mainly because it is taken for granted in its native habitat, the Congo forest.

In 1915 Dr. James P. Chapin of the American Museum of Natural History in New York had returned from Africa from an expedition mainly devoted to the okapi. Among the things he brought back were native headdresses, ornamented with bird feathers. As time went on, Dr. Chapin was able to classify all the feathers except one, which was very large. In size, shape, and coloration it did not fit any known African bird, but Chapin was understandably reluctant to announce the discovery of a new species of bird based on a single feather, with no information as to when and where it had been pulled out of a bird's carcass.

But in a Belgian museum in 1936 he found more evidence. There were two mounted birds labeled "young peacocks." They were not peacocks and, as was proved by the large spurs, they were not young. But what were they? The possibility that they might be hybrids of a peacock and some other bird was rejected by all the experts around the museum. Chapin then met people who had seen the bird in the Congo forest. He then was convinced that a relative of the Asian peacock lived in Africa and named it *Afropavo congensis*, the "African peacock from the Congo." In 1937 he went to the Congo to collect specimens. The natives needed only to be told that *itundu* were wanted; they knew the bird well because it is not especially rare.

The next discovery, scientifically more important than either okapi or Congo peacock, has some similarity with the Congo peacock story in the sense that the natives were not surprised—only the whites, and especially the white scientists. The discovery was a fish known to paleontologists and, because of the lack of fossils in the more recent geological layers, thought to have been extinct for at least 60 million years.

Its discovery was pure chance, but chance of a kind that caused confusion and a long search. In December 1938 a fishing vessel belonging to the firm of Irvin & Johnson of East London, South Africa, had come in with a large and unknown fish (that had been bright blue when alive) aboard. The manager of the company called Miss M. Courtenay-Latimer, curator of the local natural history museum, who had made friends with the trawler captains for the purpose of obtaining specimens. The fish, the manager said, was over 4½ feet long and weighed 127 pounds and the

captain had never seen one like it before. Neither had Miss L Nor could she find it pictured in the reference books in her museu

She wrote to Professor J. L. B. Smith of Rhodes University in hamstown, South Africa, who was the outstanding authority on the of the Indian Ocean near the South African east coast, and enc sketch. Smith did not believe his eyes. This sketch showed a coe fish—a sheer impossibility, since that group of fishes had been ext sixty million years. Moreover, the fossil coelacanths were 5 inch inches long, not 4½ feet. By the time Professor Smith got to East L the fish had been mounted because it had begun to decompose heat of the southern hemisphere summer. But, he could see that it coelacanth and he named it *Latimeria chalumnae* (the Chalumn river near East London). Of course he wanted more specimens, ably freshly caught specimens with all internal organs intact and in

The search lasted fourteen years—partly because the Second War began the following year, but chiefly because of the incredibl that the first specimen of *Latimeria* was a stray which had been far from its usual habitat. *Latimeria* normally lives around the C Islands to the north of Madagascar.

Other such stories could be added to the ones told here.

For example, the story of the discovery of another fish from past, *Neoceratodus*, a lungfish, in an Australian river in 1869. story of the flightless bird *takahe*, rediscovered, after having been th extinct, near Lake Te Anau on the South Island of New Zealand. story of *Neopilina*, an invertebrate which is neither a snail nor a but apparently ancestral to both, and which was dredged, alive, the ocean depth in 1952.

These stories all prove the same thing: zoology is not yet a science and the days of discovery are not yet over.

37 Annual Cumulation -
ed by Mertice M. James
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LEWIS, N. D. C.—*Continued*

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+ N Y Times p8 Ja 18 '42 550w

LEY, WILLY. The lungfish and the unicorn. 305p il $2.75 Modern age

591.5 Animal lore. Zoology 41-7770

"Mr. Ley has spent thirteen years collecting material for this book, that embodies in it, in condensed versions, some of [his] articles written for American magazines. He calls it 'an excursion into romantic zoology.' . . Its introductory chapter concerns itself with the main stream of zoological theory and research . . . but the book as a whole is divided into three parts—'one dealing with so-called mythological animals, one with animals that have become extinct within the time of man's recorded observations, and one with "living fossils."'" Scientific Bk Club R

Booklist 37:487 Je 15 '41

Bookmark 2:7 N '41

"Mr. Ley's treatment of the [hoatzin] itself is not quite worthy of this interesting creature and is somewhat incorrect. But these and other minor slips are to be expected in a volume of such encyclopedic quality. The scattering of pen and ink drawings makes us wish for many more. No matter how excellent the descriptions, fabulous and even rare living beings would gain greatly by more visual representations. An index renders the substance easily accessible. This book will remain at the head of its particular category for a long time." William Beebe

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New Yorker 17:89 Ap 19 '41 200w

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"Beyond the fact of the entertainment and instruction to be found in 'The Lungfish and the Unicorn,' the physical appearance of the book is most attractive. The drawings by Professor Gustav Wolf of New York, are a particularly welcome addition to its pages." A. H. Compton & others

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LEYBURN, JAMES GRAHAM. Haitian people. 342p $4 Yale univ. press

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Social analysis of the Haitian people, which traces their gradual development from the time of French colonial life, about 1804, to the present. Some of the subjects considered are: ethnic and historical matters; religious roles of the Vodun and the Catholic church, commerce, daily life and the Creole language spoken by the natives. The author is associate professor of the science of society at Yale University. Notes, bibliography and index.

Reviewed by J. B. Parrish

Churchman 156:18 Ja 15 '42 200w

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170 Ethics. Social ethics 41-12346

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25 May 1941 New York Times
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From "The New Woodcut." (The Studio Publications, Inc.)

Excursions Into Romantic Zoology

THE LUNGFISH AND THE UNICORN. By *Willy Ley. With drawings.* 305 *pp. New York: Modern Age.* $2.75.

THE unicorn roamed through the magic forests of man's fancy for hundreds of years; and it is sad for modern thought to see in his type of origin nothing more romantic than the rhinoceros. How happily, then, can we welcome the delightful implications of a surgical operation performed in 1933 by a biologist of Maine University, and look again at the references of credulous ages—if no such beast was ever born as this creature of highflown legend, well, it might have been possible to make a unicorn!

But as for the "mythical" sea-serpent—that we may assume to be no myth. We may even go as far as to debate the monster's nature and decide that it is no "serpent," not even a reptile, but a mammal. And after examining the bases for these and other baffling creatures of story we can pursue a further "excursion into romantic zoology" and find wonders among vanished beasts and prehistoric survivals and even look forward to the possibility of "new" discoveries at our own door.

"The Lungfish and the Unicorn" is a sound and irresistibly picturesque exploration of that richly inhabited borderland where dwell creatures of fable and mysterious fact: a world of amazing range and variety, dimly known to the public at large but now seen, certainly, to be vividly alluring. What were the giants of medieval legend whose bones men thought they had found? Elephants—yes, but why should an elephant's skull seem to be proof of the existence of the one-eyed Cyclops? The Basilisk of Viennese story a myth? Certainly—but what natural foundation was there for the unpleasant attributes of that misbegotten monster? Why did dragons live in caves? And—let us step boldly into the present—could there be dinosaurs in Africa?

For from legend the young zoologist who is our guide takes us to look at animals now extinct, like the dodo and the great auk (yes, but the auroch might be, so to speak, re-created), considers the recurrent tales of queer unknown creatures in such well-known habitats as Switzerland and the United States, and then brings his "excursion" to survey the enigma of "living fossils," especially in Australia and Africa. In the horseshoe crab we have a "living fossil" within sight of the towers of Manhattan, Mr. Ley reminds us. But for wonders and discussion alike we may press on to consider the lungfish and the platypus. There is a reason for the existence of such timeless survivals in Australia, and the romantic character of that reason should satisfy any searcher for stranger-than-fiction truth. But the same reason applies to Africa, "which still harbors more zoological riddles than any other continent," and may yet produce another big surprise.

From the unicorn to the lungfish and the okapi, this book holds more zoological oddities than can even be listed in a short review. And every one of them has a distinct and fascinating story to tell.

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8 August 1955 Washington Post, Wash, D.C.
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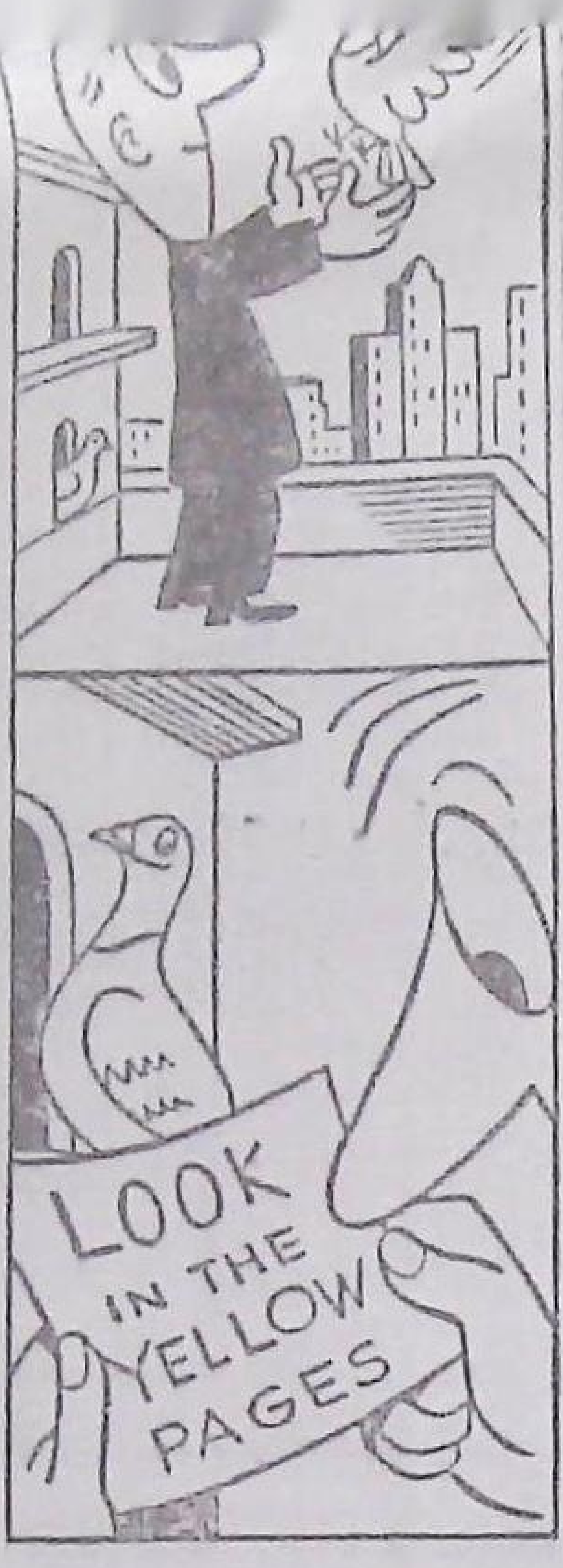

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Present-day measurements of the distance from, say, Newfoundland to Ireland are likely to be off by a thousand feet or so because one cannot triangulate across water. But with an object of known speed and course overhead, such a distance can be established with great precision.

This might be of great scientific interest and it certainly does not sound warlike but what good does it do for the average man? There are several answers.

All Facts Worth Knowing

The first one is that every fact is worth knowing. One can never tell how it will reflect on our daily life.

Some time ago chemists scratched their heads and performed endless experiments trying to understand the nature of glass a little better than they did then. One result of this work was pyrex.

At another time other chemists began to wonder about the structure of the molecules in plastics. Nothing can sound more remote from daily life. But one of the results of these studies was nylon.

Another answer is that the average man may not fly a jet fighter coast to coast in 3½ hours, but that it is still a satisfying feeling to live at a time when such things can be and are done.

In the case of the artificial satellite there is still another answer.

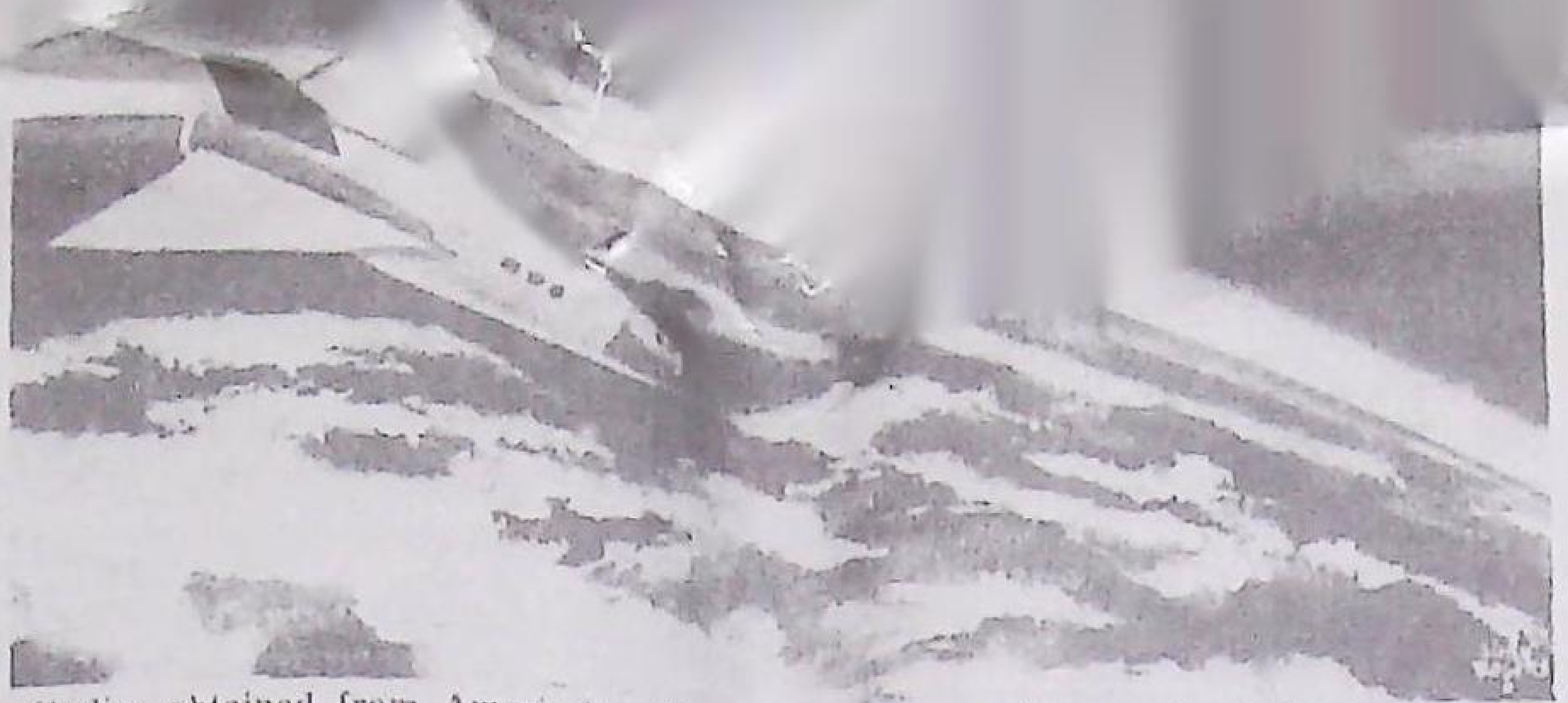
It opens the door to space.

It is one of the many preludes to space travel just as was the first functioning liquid fuel rocket motor, the first liquid fuel rocket that lifted itself off the ground, the first rocket which attained an altitude of a hundred miles.

For in time the unmanned artificial satellite will be followed by a manned rocket ship and the manned rocket ship will be followed by a manned station in space.

One Case in Detail

Let's look at just one case in small detail. About a year ago an engineer team published the idea of a rocket-powered transcontinental or intercontinental airliner. It would fly from Los Angeles to New York or from New York to London in about 1½ hours. It might even do it at a price which a business man who is really pressed for time can afford.



Studies obtained from America's artificial satellite are expected to contribute to the construction of aircraft which will span the continent in 90 minutes. This drawing shows a transcontinental plane being brought to its required altitude by a manned booster plane, which later returns to the takeoff field.

But such a rocket-propelled airliner could not really be built now. In the course of its trip it would leave the atmosphere and the designing engineer would want to know how much it would heat up in day time, or cool off at night, in space in one hour.

He would be even more eager to know how much it heats up from skin friction when it re-enters the atmosphere. He would want to know how many dust particles would strike it during that hour. If the number should be very small, this might be neglected entirely. If it is large, something can be done about it with a double skin. The question is whether a double skin would be needed. It has weight and weight costs fuel.

Questions Now Unanswerable

Nobody can answer such questions now, but all the answers will be in after the first satellite has burned up in the upper atmosphere.

If, after the information has been deciphered and digested, such a transcontinental rocket liner is actually built, it will be a two-stage ship. The large carrier plane will lift it off the ground and into the stratosphere and provide the carried rocket liner with a good dose of speed. It will then land while the other plane goes on under power to land some 3000 miles from home base after 90 minutes of flight, most of it unpowered.

Any good-sized rocket fired from that "upper" plane while en route will be another artificial satellite, if more are needed. And if that whole two-stage rocket liner were placed on top of a still larger rocket (which would become a new first stage) the top stage of the rocket liner could take an orbital path and become a manned satellite.

Again the temporary manned satellite would mainly have the purpose of finding out a few things.

This time the questions would no longer concern space, but rather man in space. Whether a man could stand the speeds involved is no problem at all. Man has no organ that enables him to sense speed.

When you speed along a highway you feel the bumps in the road, the vibrations of the engine, the airstream passing by. But you cannot feel speed directly. In an airplane most of the sensations misunderstood for "speed" disappear. We can not even feel speed. But we can feel changes in speed, accelerating.

Even though no man has ever taken a ride in a V-2 or Viking rocket we know that he could stand the acceleration of these rockets if he did. It so happens that accelerations can be imitated in large centrifuges and volunteers had themselves tested. From these tests we know that any person in good health can stand much higher accelerations, and for a longer time, than will ever actually occur in a rocket ship.

What we cannot test on the ground, and therefore do not know well, is how people will react against the opposite to

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15 Oct 1952 page 14, col 3, 4, Eastern Edition, Boston, Mass
Christian Science Monitor,

volved now, while we are fighting in Korea. The lives of everyone would be involved if that conflict were to grow into world war.

All of us know that what is ahead is a dangerous, expensive, painful struggle—a struggle that can only be won for peace and freedom if we are willing to put our brains, our money, our sweat, and our blood into the effort.

Troops in Korea

Those are the facts. You know them. I know them. And we once had reason to suppose that the general knew them.

Instead, he has been asking people to vote for men who have protested, and opposed and hamstrung our foreign policy measures, men who have tried

Salt Lake City

Following is a partial text of a speech by Gov. Adlai E. Stevenson here.

. . . What is this "American idea" which we so justly venerate? I suggest that the heart of it is the simple but challenging statement that no government may interfere with our conscience, may tell us what to think. All our freedoms, all our dynamic unleashed energies, stem from this.

We Americans just naturally talk like this: "No government can tell me what to think. No government can tell me what to do, unless it can prove that the common good is served by such interference." This is the American way of living.

But government, keeping its hand most carefully away from that forbidden field, may and,

Because we have always thought of government as friendly, not as brutal, character

the determination to spend in money and in labor and in hard thought whatever is needed to save ourselves and our world . . .

U.S. Army Seeks Stockpile To Support Atomic Artillery

By the Associated Press

Aberdeen Proving Ground, Maryland

Secretary of the Army Frank Pace, in an unveiling ceremony for the first atomic artillery gun, said the Army is seeking to have a "proper share" of nuclear materials earmarked for its use.

Mr. Pace set forth the Army's claim to allotment of fissionable material in an address prepared for delivery at a demonstration of the 280-millimeter, all-purpose gun and three of the latest-model tanks. The Army secretary said:

"The Army believes strongly in the concept and doctrine underlying the application of atomic energy to the battlefield. We have, therefore, exerted strong efforts to insure that a proper share of our national stockpile of fissionable materials is fabricated and earmarked for such use."

Design Changed

The phrasing used by Mr. Pace left open the question of whether the Army actually has any atomic ammunition to use in the big mobile weapon. Blueprints drawn in 1944 envisioned it as a general purpose gun for firing conventional projectiles, but the design was changed in 1949 to provide also for use of nuclear fission shells.

Mr. Pace's remark about exerting strong efforts to get allocation of material to the Army also suggested that the Atomic Energy Commission had to be persuaded.

Details of the new gun became known recently when reporters and photographers saw it maneuver and fire in demonstrations here. Invited to the unveiling ceremony were members of Congress and officials of the several companies that collaborated in development and manufacture of the gun.

Speed and Mobility

The 280-millimeter gun (a caliber slightly more than 11 inches) can fire at targets 20 miles away with what the Army claims is pin-point precision — "four times more accurate at long range than any mobile artillery

In demonstration, the gun shows a high degree of mobility, despite its 85-ton total weight. Its two tractor-power cabs, at front and rear of the rifle which is almost 40 feet long, can take the gun along a highway at a speed of about 35 miles an hour, then roll off the road and start cross-country.

The Army never has been entirely happy over the fact that tactical aircraft for dropping bombs, atomic and otherwise, is controlled by the air force and is subject to limitations imposed by weather and visibility. Obviously with this in view, Mr. Pace asserted that:

"This artillery piece opens up new vistas in the capabilities of our army to discharge its primary responsibilities in the field of land combat. It provides our ground commanders with fire support of great range, flexibility, and volume, which can be delivered with extreme accuracy and reliability at any time of the day or night regardless of zero ceilings, storm, hail, or other conditions.

Tactics Reappraisal Stressed

"In my view, this atomic weapon can prove to be one of the vital factors in helping to force decisive results on the battlefield."

At another point Mr. Pace emphasized the atomic gun must not be considered the utimate weapon.

"Let me make it perfectly clear," he said, "that I do not believe that this weapon is final or that it is, in and of itself, compelling. With the completion of this Army atomic weapon, there is more need than ever for a continuing and objective reappraisal of the concepts, doctrines, and techniques of ground warfare. Realizing fully that the ultimate decisions of war relate to battle on the ground, the Army accepts the responsibility for gaining such decisions at minimum cost, primarily in human lives and secondarily in other national resources."

The Army so far has not claimed to have fired an actual atomic shell from the new gun. All demonstrations seen to date

Travel Into Remote Space Called Possible Even Now

By a Natural Science Correspondent of The Christian Science Monitor

New York

Experts on rocket ships and the conditions to be encountered in venturing beyond the earth's gaseous envelope, meeting at Hayden Planetarium here, have agreed that "space travel is possible now."

This is the second symposium of its kind to be held at 81st Street and Central Park West, where almost 10,000 persons have registered for the first air voyage around the moon.

Robert R. Coles, Planetarium chairman, has not announced how the initial crew and passengers will be chosen from among those signed up. But in discussing the role of the Planetarium in space travel, he stressed the need for educating the public on what is possible, rather than on what seems to be impossible in travel beyond the influence of gravity.

Willy Ley, author of books on rockets, missiles, and the conquest of space—one of the founders of the German Rocket Society—asserts that man's attack on the third dimension will come about first through construction of a doughnut-shaped way-station in space. Living conditions there will be cramped and complicated, he says, very much like life in a modern submarine.

Self-Contained Station

Such an outpost in the sky will have to be a self-contained community "with all man's needs from air-conditioning to artificial gravity" supplied from the earth, he said.

As symposium coordinator, Mr. Ley pointed out that plans for such a space station are already in the blueprint stage, that the project is "not for the future, but for the present. Work on it could start tomorrow."

Dr. Wernher von Braun, technical director of the United States Army Ordnance guided-missile development group, a codesigner of the German V-2 rocket, was introduced as the author of such blueprints. Much of his talk on "the early steps in the realization of the space station" was concerned with very practical problems having to do with the job of building three-stage rocket ships capable of carrying men and materials out to mile-post 1075.

There an initial velocity would keep everything flying round the earth in a two-hour orbit that would always remain the same, according to figures of the rocket scientists.

As Dr. von Braun told the first symposium held here a year ago, "it may be only a matter of 10 or 15 years before this planet has a new companion in the skies, a man-made satellite, his first foothold in space."

With nature providing the motive power, a neat balance can be maintained between its speed and the earth's gravitational pull

step, he says, to circumnavigation of the moon.

It's value to the military was suggested in the statement that technicians aboard such a space station, using specially designed powerful telescopes, radarscopes, and cameras, "can keep every ocean, country, and city under constant inspection.

"Development of the space station is as inevitable as the arrival of dawn each day," he said. "Man has poked his nose into space already with rocket missiles and is not likely to pull it back."

The superiority of liquid fuels over solid was discussed—supplying separate tanks for fuel and oxidizer, tossing overboard the whole ancient pyrotechnical art of rocket making as inherited from the Chinese.

Meteorite Bumpers

Motors, pumps, valves, tubing, oxygen for crew members, meteorite bumpers for protection from stellar artillery, condensed foods, and the problem of getting up sufficient initial speed to carry rockets out to the necessary distance were also considered. Problems of navigation were taken up by Mr. Coles and others.

Dr. Fred L. Whipple, Harvard astronomer, said that studying astronomy from the proposed space station would doubtless present exceedingly strange aspects of familiar orbs.

At present, the earth's atmosphere, even on a perfect night, will blanket out many details of the surface of the moon, the planets, and distant star groups. It causes the light from stars to twinkle continuously, cut out the extremely significant far-ultra-violet light and much X and gamma radiation as well.

Others on Program

Astronomy from a station 1,075 miles out will end the present blindness of astronomy, he stated, perhaps make visible stars that hardly show even on special photographic plates. "The Milky Way itself might be markedly changed—I wish I knew just how."

Also on the program were Milton W. Rosen, director, the Viking rocket project, Naval Research Laboratory, upholding "A Down-to-Earth View of Space Flight"; Dr. Fritz Haber, astrophysicist, University of California at Los Angeles, "Human Flight at the Limits of the Atmosphere," and George O. Smith, radio research engineer, Emerson Radio Corporation, discussing "Radio Communication Across Space—Ship-to-Ship and Ship-to-Planet."

The symposium held a year ago has just been printed in book form by the Viking Press, edited by Cornelius Ryan, with illustrations in color by Chesley Bonestell, Rolf Klep, and Fred Freeman.

Noted for Wood Carving

The Newars, the original people

Boston Wharf Company	42¼	46
BostonWovenHoseandRubber	17	18⅛
Campbell A & Co Inc	14¼	16¼
Chapman Valve Manufac	43¼	47
Collyer Insulated Wire Co	16¼	18⅝
Colonial Stores	33¼	36
Consolidated Rendering	54¼	58¼
Crowell-Collier Pub Co	7⅛	8
Dewey & Almy Chemical Co	15⅛	16½
Draper Corp	18½	19⅞
Dun and Bradstreet	26¼	28½
Durez Plastic & Chemical	20⅜	22⅞
Exolon Co.	12¼	14¼
Fruit of the Loom	39¾	44½
Giddings & Lewis Mach. Tool	13⅛	14¾
Graton & Knight Co	12½	15
Graton & Knight Co pr pf	28	
Grinnell Corp	88¼	
Harrington & Richardson	2⅞	3¼
Heywood-Wakefield Co	32	34¼
Heywood-Wakefield Co pf B	17⅛	19¾
Hollingsworth and Whitney	34½	37½
Jones & Lamson	20¼	33¾
Kaiser Steel	10¼	11¾
Kaiser Steel preferred	20½	22⅛
Kendall Company	37	40
Landers Frary and Clark	23⅞	26½
Long Bell Lumber	20¾	22½
Ludlow	31⅝	34⅝
Martin Rockwell	18¼	19¾
Moxie Company	1	1⅜
National Shirt Shops	13	13½
Nashawena Mills	65	
Naumkeag Steam Cotton	20	22½
New England Lime	7	9
Newmarket Manufacturing	13⅞	15
Nicholson File Company	33¼	36¾
Northwestern Leather	15⅝	17
Parker Appliance	10⅞	13
Photon Inc.	27¾	31
Plymouth Cordage Company	44	47½
Portsmouth Steel	13⅝	15
Quincy Mkt. Cold Stor & W	110½	—
Reece Corp	10⅝	12½
Reed Prentice	7¼	8½
Remington Arms Co Inc.	7	7⅞
Riley Stoker	18	19⅞
Rockwell Manufacturing	26½	29
Saco Lowell Shops	15⅛	16⅝
Sagamore Manufacturing Co.	100	110
Scott & Williams	5½	6½
Seaboard Finance pf	28¼	30¾
Simplex Paper Corp	10	11⅝
Southern Adv. Bag-Paper	26	28⅛
Sprague Elec.	66¾	72
Tampax Inc	13½	15⅛
Texas Gas Transmission Corp	16⅛	17⅝
Thompson sI ndustries pf	23¾	27½
Tracerlab	8⅞	10½
Timely Clothes	12¼	14
Transcontinen Gas Pipe Line	19½	20⅝
US Envelope Company	67⅞	72½
US Envelope Co 7 pf	64¼	69½
Verney Corp	4⅞	5¾
Wamsutta Mills Inc	11⅝	13⅝
Warner & Swasey Co.	14⅛	15⅞
Warren Bros	16⅝	18⅛
West Point Manufacturing	25⅝	27¾
West Virginia Prod	3⅞	4⅛
West Virginia Water Service	20¼	22¼
Weyerhaeuser Timber	67¾	72¼
Whitin Machine Works	23⅞	25¼
William Whitman	17¼	18⅝

*Ex-dividend, †Not qualified for sale in Massachusetts.

Bank Stocks

BkAmNTS (SF) 1.60	30¾	32¼
Bk of Man 1.40	32⅝	34¼
Bk of NY 14a	361	373
Bankers Tr 2	48¾	50¼
Chase Nat 2a	43¾	45¼
Chem Bk&Tr 3	48¾	50¼
Cont Bk & Tr at	6¼	7
Cont Ill Chi 4b	88½	91½
Cor Exch 3	66	67½
Empire Tr 3b	154	159
Fst Nt (Bos) 2a	50½	53½
Fst Nat Chi 8b	242	248
Fst Nat NY 20	388	400
Guaranty Tr 14	323	332
Hanover Bk 4	94½	97½
Irving Tr 1	22½	23¾
Kings County 80	1430	1480
Manuf Tr 2.60	63⅝	65⅝
Natl City 2	51⅞	53⅞
Nat Shawmut 1.40	31¼	31¾
NY Trust 4a	113	116
Public Nat 2a	47½	48⅝
United States 14	200	370

Insurance Stocks

	Bid	Asked
Aetna Cas (2½a)	92	96
Aetna Ins (2a)	87	90
Aetna Life (2a)	93½	97½
Agricultural (3a)	82	
AmAlliance (1.20a)	34	36
Am Auto (2)	47¼	49¼
Am Equit (1½)	28	30
Am Fid & Cas (1)	17¾	19¼
Am Ins NJ (1)	26¼	27½
Am Re-Ins (1.20)	35¼	37¼
Am Surety (3)	50¾	53¾
Bank&Ship (2.40a)	55½	59½
Boston (2.60)	69¾	72¼
Camden Fire (1)	23	24¾
Col Nat Life (1.60)	60¾	67½
Conn Gen L (2)	150	155
Contin Cas (2a)	81	84½
Crum & For (1.60)	41½	43½
Employ Gr (1.80)	44⅝	46⅝
Federal Ins (3a)	65	
Fire Asso Ph (3)	68¾	70¾
FiremFd (SF) (1.60)	57¾	59½
Firem Nwk (.80)	26	27¼
Gen Reinsur (1.60b)	37	39
Glens Falls (2)	66¾	68¾
Globe & Rep (.80)	16½	18½
Globe & Rut (½g)	33	35
Gt Am Ins (1.20a)	37	38½
Hanover Fire (1.60)	38½	40½
Hartf'd Fire (3)	151½	156½
Hfd St Blr (1.60)	41½	43½
Home Ins (1.60)	39	41½
Ins Co N A (2a)	82½	84½
Jer Ins NY (1½a)	35	
Lincoln Nat L (1)	144	148
Maryland Cas (1.20)	24½	26½
Md Cas pr pf (2.10)	48½	51½
Peerless (.70)		
Phoenix (3)		
Prov-Wash (1.40a)		
Rein Cor NY (.30a)		
Rep Ins Tex (1.20)		
St P F & M (.80)		
Seab'd Sur (2.40a)		
Security (1.60a)		
Springfield (2)		
Std Accid (1.60)		
Travelers (12a)		
U S Fid G & (2)		
U S Fire (1.40a)		
U S Guar (2.40a)		
Westch'ter (1)		

a—Also extra or extras. dividend. e—Declared or pa year. g—Paid last year. h paid after stock dividend or

Investment Tru

Affiliated Fund Inc
American Express
American Business Shares
Axe Houghton Fund
Baystate Corp
Blair & Co
Boston Fund
Broad Street Investing
Bullock Fund
Century Shares Trust
Chemical Fund
Christiana Securities Co 85
Concord Fund
Consolidated Investment Tr
Diversified Tr E
Eaton & Howard Bal Fd
Eaton & Howard Stock Fd
Fidelity Fund Inc
First Boston Corp
Formula Fund
Fund Investors Inc
General Capital
General Investors Trust
Group Securities Inc.
  Automobile Shares
Low Priced Shares
  Railroad Bonds
  Railroad Equip Shares
  Steel
Hudson Fund
Incorporated Investors
Institu Shrs Bank Group
Inst Shrs: Insur Group
† Keystone Custodian Funds

	Bid	Asked	
B-1	26.57	27.79	S-1
B-2	24.19	26.39	S-2
B-3	18.33	20.00	S-3
B-4	10.88	11.88	S-4
K-1	17.72	19.33	K-2

Knickerbocker Fund
Lexington Tr Fund
Loomis Sayles Mut Fd
Manhattan Bond Fund
Mass Invest Tr
Mass Inv Growth
Mass Life Fund
Mutual Fund Boston
Mutual Invest
Nation Wide Bal Fund
National Securities and Re
  Bond
  Low Pr Bond
  Pref Stock
  Income
  Specialtive
  Stock
  Ind Stock
  Low Pr Stock
National Investors Corp
Natural Resources of Canada
New England Fund
Diversified Funds
  Automobile
  Diversified Inv
  Railroad
  Railroad Equip
  Steel
Northeast Investors Trust
Putnam Fund
Railway & Light Sec
Repub Invest Fund
§Scudder Stevens & Clark
Shareholders Trust
State Street Invest
Television Fund
Wellington
Whitehall Fund

*Ex-dividend, †Sales prices §Net Asset Value

Dow-Jones Ave

By the United Pre

October 14, 195

	Open	High	Low
30 Inds	270.80	271.60	269.4
20 Rails	101.10	101.82	100.6
15 Utils	49.97	50.08	49.7
65 Stocks	105.00	106.24	104.5

Closing Average

1952 High

30 Inds	280.29	Aug. 11
20 Rails	104.69	Aug. 7
15 Utils	51.12	Aug. 6
65 Stocks	108.39	Aug. 7

What Stocks I

By the Associated P

Advances
Declines
Unchanged
Total Issues
New 1952 Highs
New 1952 Lows

Stock Transactio

Tuesday's Sales
Today's sales (est.)
1952 volume to date

WOOSH!... And I   5 August 1955
Heads for its Tour   Washington Post page 25

can fliers after their arrival in Hongkong. Col. Arnold is standing at left.

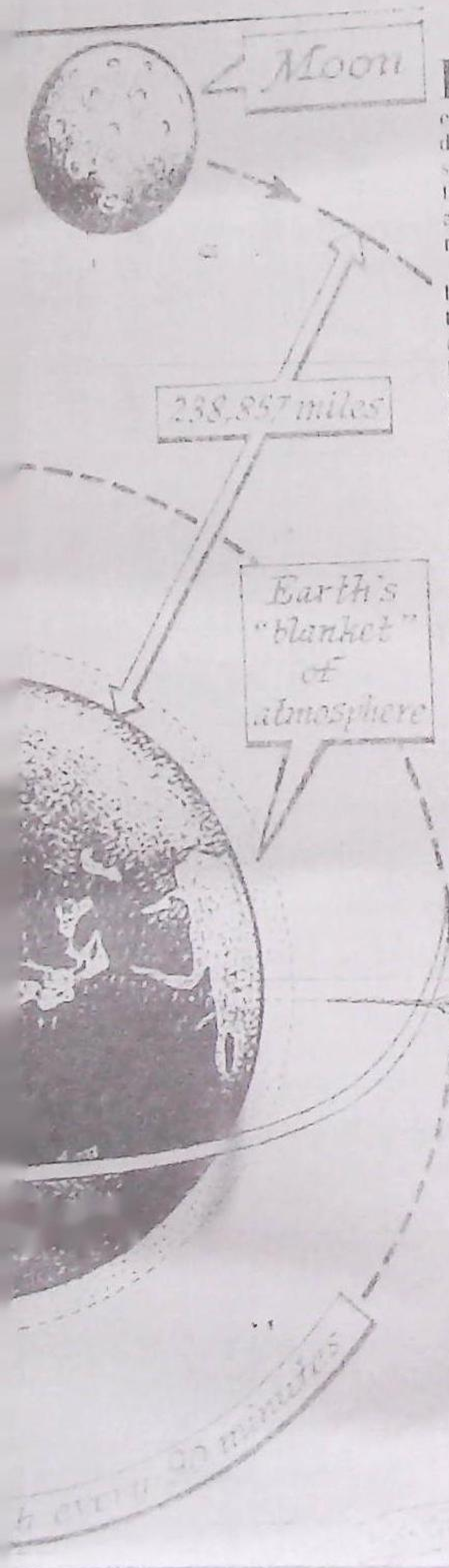
(Story on Page 1)

Photos by Associated Press and International News

America's Satellite Tour of Outer Space

(First of a series)

By Willy Ley



International News

roposed unmanned satellite about 300 of the moon.

LATE in 1956, or early in 1957, representatives of Congress, generals, air generals and admirals, delegates of important scientific institutions and possibly members of the Diplomatic Corps will stand under a blue morning sky and gaze at a tall rocket.

The rocket will still be shrouded in the mechanical scaffolding of a Gantry crane. Technicians will still be checking electrical connections, scientists will be going over instrument calibrations and engineers will be looking once more at trajectory calculations which, by that time, they can recite in their sleep.

Airplanes will roar overhead to warn off all shipping for 200 miles to the east along the line of the calculated flight path. Soon after the visitors will be packed into cars and buses. The fueling operation is due to start and heavy tanker trucks are inching up to the pipeline connections.

About the Author

WILLY LEY, the author, has long been considered one of the world's foremost experts on rockets and the possibilities of space travel. A native of Germany, he helped organize and headed up the German Rocket Society, and achieved world acclaim as a physical scientist. With the Nazi rise to power in 1935, Ley came to this country, where his knowledge brought him even greater fame and prestige. As an American, he helped greatly in the popularization of rocketry.

The visitors will be taken half a mile from the take-off site. This is not only the distance considered safe in case of accident, but also the distance from which events can be seen best.

Twenty minutes before X-hour, the moment of take-off, there will be the traditional red flare which proclaims "X-minus 20." Twenty minutes to go—they are, at any big rocket shot, the longest 20 minutes.

Suddenly the loud-speakers begin to call out the count-down. At the moment of "Zero—Rocket Away" the visitors will see a flame below the rocket and what looks like a puff of smoke.

It is actually dust kicked up by the exhaust blast, roaring out of the exhaust nozzle at better than 7,000 feet a second. By the time the sound reaches the visitors the rocket already has lifted.

United Press

Willy Ley (left), author of the accompanying article, discusses the forthcoming launching of a man-made satellite with Dr. Wernher von Braun, famed rocket expert.

IT CLIMBS slowly like an elevator at first, but at the end of every second it moves about 50 feet a second faster than at the beginning of that second.

After 20 seconds there isn't really much to see any more except for a bright dot in the sky but the loud-speakers will keep everyone informed. One minute after take-off the rocket is at 120,000 feet and the bulk of the atmosphere is below. The rocket is no longer climbing vertically, but slantwise in an easterly direction. This is important for reasons of fuel economy because that's the way the earth turns.

One minute and 15 seconds after takeoff comes a crucial moment: "the separation." The big rocket is nearly out of fuel and it is time for the smaller rocket carried in the nose of the first to break free and take over.

"Separation accomplished," the loud-speakers report.

Now the second smaller rocket forges ahead under its own power, climbing at a slant.

But the bigger first rocket still follows. It is no longer under power, but it takes a few minutes until its momentum has been eaten up by gravity and air resistance left at such heights.

Another minute and 15 seconds later, at a height of around 45 miles, there is another separation.

Now the "third stage" the still smaller rocket in the nose of the second rocket, breaks free. The first rocket built up to a speed of $1\frac{1}{2}$ miles a second—rocket engineers do not like to speak in "miles per hour," the figures become too unwieldy—and the second rocket added the same amount.

When the third rocket takes over it is already moving at three miles a second before it has ever burned a single drop of its own fuel. As the third rocket climbs slantwise through the outer layers of the atmosphere the first rocket is just about to fall back to the ground, the second is, of course, still climbing, though on momentum only.

NOT QUITE four minutes after initial take-off the third rocket stops burning and continues like a projectile. About one minute after that No. 1 splashes into the ocean, 200 miles from the take-off site. Ten minutes later the loud-speakers announce that No. 2 has hit the water, 900 miles from the take-off site. And after three-quarters of an hour they say: "Adaptation Maneuver accomplished." This means that 200 miles out in space, and half-way around the earth, the third rocket has produced a final burst of speed.

The reason is this: The artificial satellite, which is the "payload" in the nose of the third rocket, is supposed to take up a closed circular path around the earth. This circle should be concentric with the circle formed by the surface of the earth underneath, or rather inside it. Without the adaptation maneuver the path of the satellite would be closed and might be more or less circular, but it would not be concentric with the "periphery" of the earth.

The two circles would be inside each other all right but in a lopsided manner. Because of that, part of the satellite's path would lead through the upper atmosphere and air resistance would gradually reduce its speed. And with reduced speed it would crash soon.

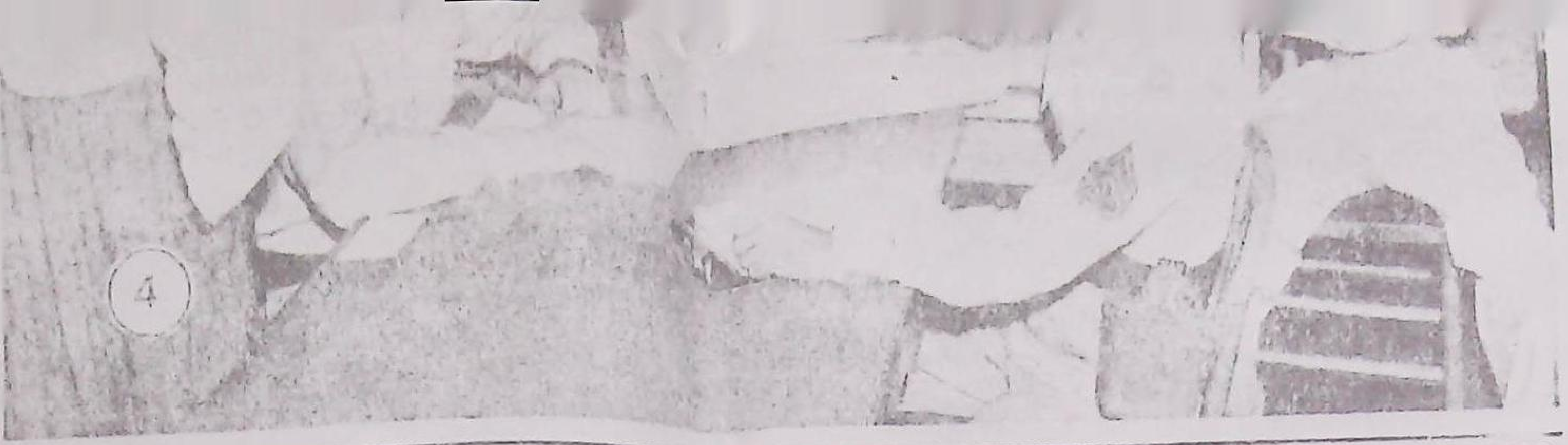
It will take only 45 minutes from the word "zero" for the great experiment to be completed in its first phase. No. 2 begins: Finding out what the satellite does and what happens to it.

Saturday: A Package Falls Around the Earth.

6 August 1955 Washington Post, Wash, D.C. page 21

Raymond Reynolds [illegible] defendant (Miss Larsko) comes to trial before [illegible] Capt. Karl Schmeidler, Maj. Eli F. Nobleman, Capt. James H. Ashida and Sgt. John F. Lally. Schmeidler, Nobleman and Lally, all lawyers, are members of the group's legal team.

In addition to training in military government, the group is engaged in maneuvers involving firearms and grenades. The reservists will return to Washington area homes Aug. 13.



id Fuel Rocket
lite Into Space

[illegible] which carries the artificial satellite into space, [illegible] a three-stage liquid fuel rocket [illegible] nose and the second rocket carries a third and still [illegible] whole assembly to reach space finally carries the pack[illegible]

[illegible] instruments could be [illegible] into space [illegible] discussing

[illegible] and philosophers we still don't know [illegible] it works, and that is good enough [illegible] into space.

[illegible]

Even before America's unmanned satellite is launched scientists are plotting the flight of manned "moons." This one was sketched on proposals outlined by Maj. Alexander P. de Seversky, famous aviation pioneer.

fuel rocket in its nose. One of the points of the paper was that all the various types of rockets needed already exist. So does the balloon.

Another idea advanced was to have a fairly small assembly of liquid fuel rockets carried aloft by a large jet bomber. The reason again was to leave as much air resistance as possible below and the jet bomber also would supply some of the needed speed. Moreover, the jet bomber's pilot could fly his plane in the proper direction when launching the rocket.

Offhand, however, the method of having a large three-stage rocket taking off directly from the ground seems the most practical for various technical reasons. It is, of course, possible that the second stage may run on a different liquid fuel than the first stage (as was the case in Project Bumper) but this is comparatively unimportant.

The important point is that a lateral velocity of four and a half miles per second is reached above the atmosphere. And the curious fact is that with a single rocket shot we'll probably get two artifical satellites.

Why?

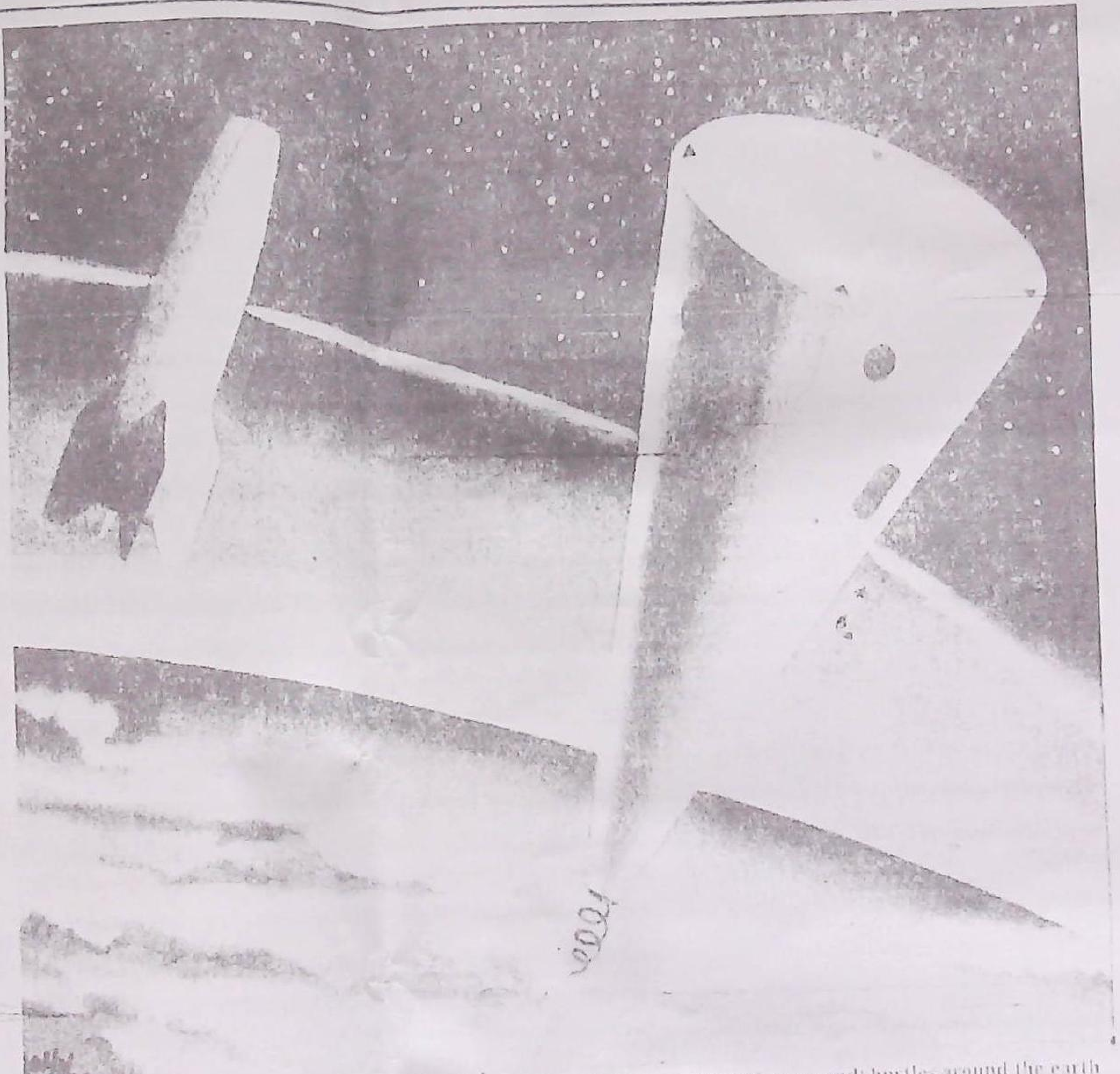
LET'S RECONSTRUCT again what must happen. Here is the top rocket of the whole assembly. The lower stages have been shed during the climb through the lower atmosphere, the stratosphere and the top layer, the ionosphere. The top stage is in space and has settled in its orbit around the earth. In its nose is the satellite proper, the package of scientific instruments.

To work to their fullest capacity they must be free of the rocket. Mechanically this is rather simple, it only needs a slight push. One way of doing it would be to mount the instrument package on a tensed spring. A release mechanism is coupled with a timing device that starts running at take-off.

Fifty minutes after take-off the release clicks and the spring pushes the "satellite" out of the rocket. Or else it could be done with a puff of compressed air, or even a tiny powder charge. The engineer will pick whichever weighs least. But the top stage of the rocket assembly is in space too and has little reason to fall back as has the satellite. The inevitable result is that there will be two bodies circling the earth some distance apart.

But if this release should fail to work, or the instruments do not function for some trivial reason? The answer is that the experiment would be worth the expense and the effort even then.

Sunday: Which Way Around the Earth?



A space package (foreground) hurtles around the earth at 18,000 miles an hour, carrying instruments that send data back to scientists. In background is third-stage rocket which imparted final push to space package.

defendant [illegible] comes to trial before [illegible] Capt. Karl Schmeidler, Maj. Eli J. Nobleman, Capt. James H. [illegible] and Sgt. John E. Lally. Schmeidler, Nobleman and Lally, all lawyers, are members of the group's legal team.

In addition to training in military government, the group is engaged in maneuvers involving firearms and grenades. The reservists will return to Washington area homes Aug. 13.

Three-Stage Liquid Fuel Rocket Will Propel Satellite Into Space

(Second of a series of [illegible])

By Willy Ley

WHAT I DESCRIBED yesterday, the takeoff of the rocket which carries the artificial satellite into space, was written under the assumption that the satellite would be carried by a three-stage liquid fuel rocket.

This means a rocket which carries a smaller rocket in its nose and the second rocket carries a third and still smaller rocket. The third rocket, the only portion of the whole assembly to reach space, finally carries the package of instruments which is the artificial satellite.

But there are several ways in which a package of instruments could be tossed into space. Before discussing them something must be said about gravity.

In spite of more than 250 years of hard thinking by scientists and philosophers we still don't know what gravity is. But though we do not know its nature we do know how it works and that is good enough for all practical purposes, from the forecasting of eclipses to shooting things into space.

It works like this: If a missile fell from a height of 100 miles it would strike the ground with an impact velocity of about one mile a second. (In reality it would be slowed down by air resistance, but that is another story.) Conversely, a rocket which attained a speed of a mile a second would rise to about 100 miles. Many V-2 rockets have done this.

The faster Navy rocket Viking has climbed to 158 miles by producing a speed which is the impact velocity for a fall from that height.

And in Project Bumper, which was a two-stage rocket made up of a V-2 as the first and a WAC Corporal rocket as the second stage, the WAC Corporal reached a maximum speed of about 1½ miles a second. It climbed to 250 miles.

IF A ROCKET, or a rocket assembly, could reach a velocity of 5 miles a second it would climb to more than 1000 miles in a vertical shot.

With 7 miles a second it would not come back, for that is the highest velocity the earth's gravity could produce.

Compare the earth's gravity to a rubber band. The harder the pull (by the rocket) the farther it stretches. At 7 miles a second it snaps. ~~But they don't have to snap~~ it to stay in space. All these rockets fall back ultimately because they are fired vertically or very nearly so. If fired at a slant you get a different effect.

It is like swinging a stone around on a rubber band. The band is stretched, but not to the breaking point. On the other hand, it is stretched enough so that it cannot pull the stone back. All it can do is to prevent it from going farther away.

The effect is that the stone—or rather the package of scientific instruments which is the satellite—literally falls around the earth and will continue doing so for eternity unless something stops it or reduces its speed so that earth's gravity gets the upper hand. This nice balance takes place when the rocket moves with a lateral speed of about 4½ miles a second.

NO AMOUNT of ingenuity can change this speed requirement. But it can be accomplished in various ways. One team of engineers presented a paper at a scientific meeting last year in which launching from a balloon was advocated.

The balloon was to carry the rocket assembly to about 60,000 feet which would leave most of the troublesome air resistance below. Then a set of four very heavy solid fuel (smokeless powder) booster rockets was to go into action. They would carry a liquid fuel rocket with a smaller liquid fuel rocket in its nose. One of the points of the paper was that all the various types of rockets needed already exist. So does the balloon.

Another plan advanced was to have a fairly small assembly of liquid fuel rockets carried aloft by a large jet bomber. The reason again was to leave as much air resistance as possible below and the jet bomber also would supply some of the needed speed. Moreover, the jet bomber's pilot could fly his plane in the proper direction when igniting the rocket.

Offhand, however, the method of having a large three-stage rocket taking off directly from the ground seems the most practical for various technical reasons. It is of course possible that the second stage may run on a different liquid fuel than the first stage (as was the case in Project Bumper) but this is comparatively unimportant.

The important point is that a lateral velocity of four and a half miles per second is reached above the atmosphere. And the curious fact is that with a single rocket shot we'll probably get two artifical satellites.

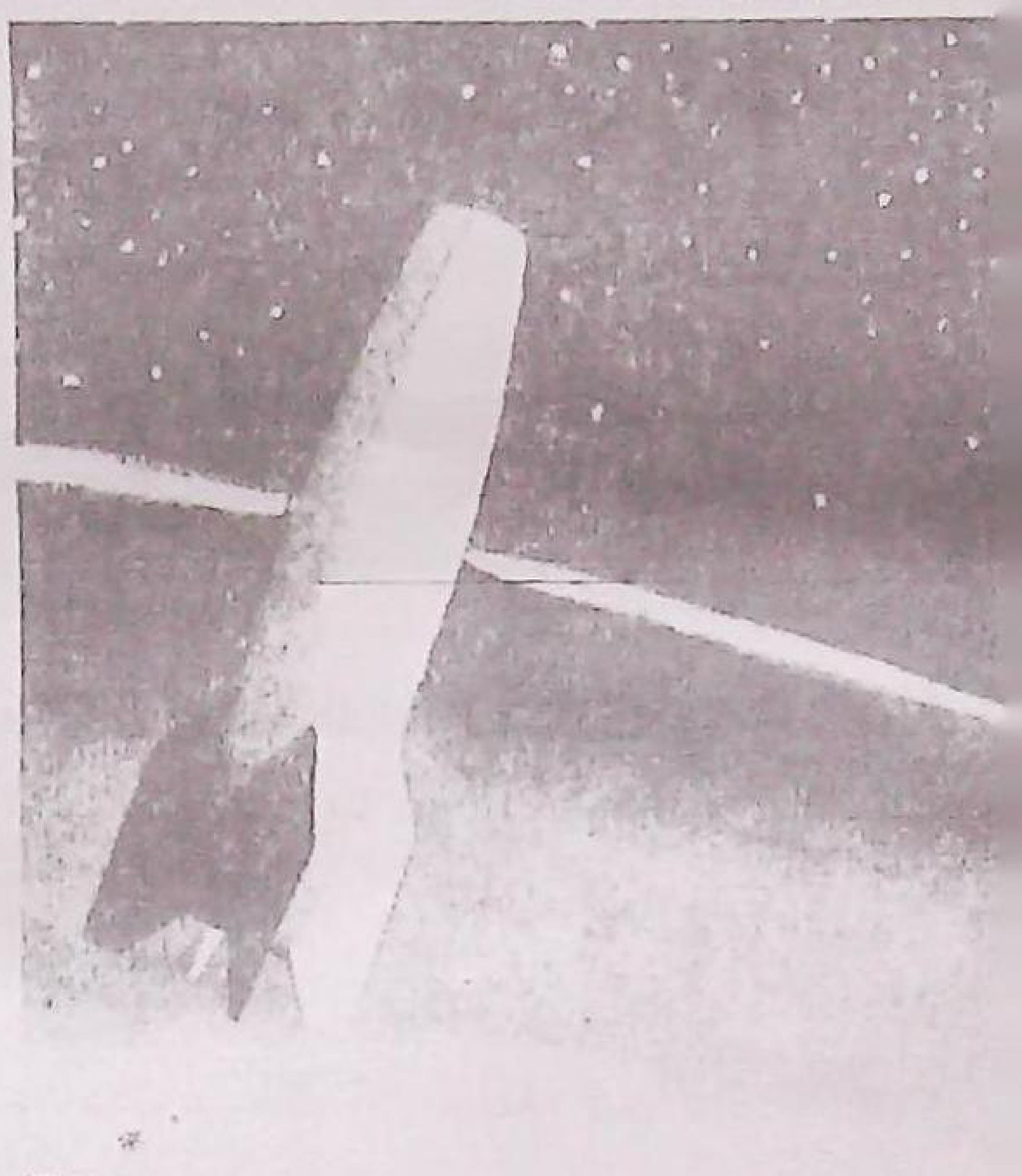
Why?

LET'S RECONSTRUCT again what must happen. Here is the top rocket of the whole assembly. The lower stages have been shed during the climb through the lower atmosphere, the stratosphere and the top layer, the ionosphere. The top stage is in space and has settled in its orbit around the earth. In its nose is the satellite proper, the package of scientific instruments.

To work to their fullest capacity they must be free of the rocket. Mechanically this is rather simple, it only needs a slight push. One way of doing it would be to mount the instrument package on a tensed spring. A release mecha

International News

Even before America's unmanned satellite is launched scientists are plotting the flight of manned "moons." This one was sketched on proposals outlined by Maj. Alexander P. de Seversky, famous aviation pioneer.



Satellite to 'Report' to Earth

By Willy Ley

There are three conditions any artificial satellite must fulfill, no matter of what shape, size or design.

The first is that it must move at the rate of about 4½ miles a second.

The second is that it must move above atmosphere, else it will lose speed and eventually enter denser layers of the atmosphere where it will burn up like a shooting star.

The third is that it must follow a so-called Great Circle.

The term Great Circle course is fairly familiar now because airliners use it whenever feasible, but the precise meaning of it still escapes most people. Actually it is quite easy to explain. If you slice up a ball of clay each slice will form a circle but the largest circle will be formed by the slice which goes through the center of the ball. It makes no difference whether you slice vertically, horizontally or at any angle in between, the slice through the center will always produce the largest circle and any portion of this will be a Great Circle.

A large number of Great Circles are marked on any globe. Any meridian is a Great Circle. So is the equator. But many other Great Circles are possible. The artificial satellite must follow one of them. Which should it be?

Instrument Within

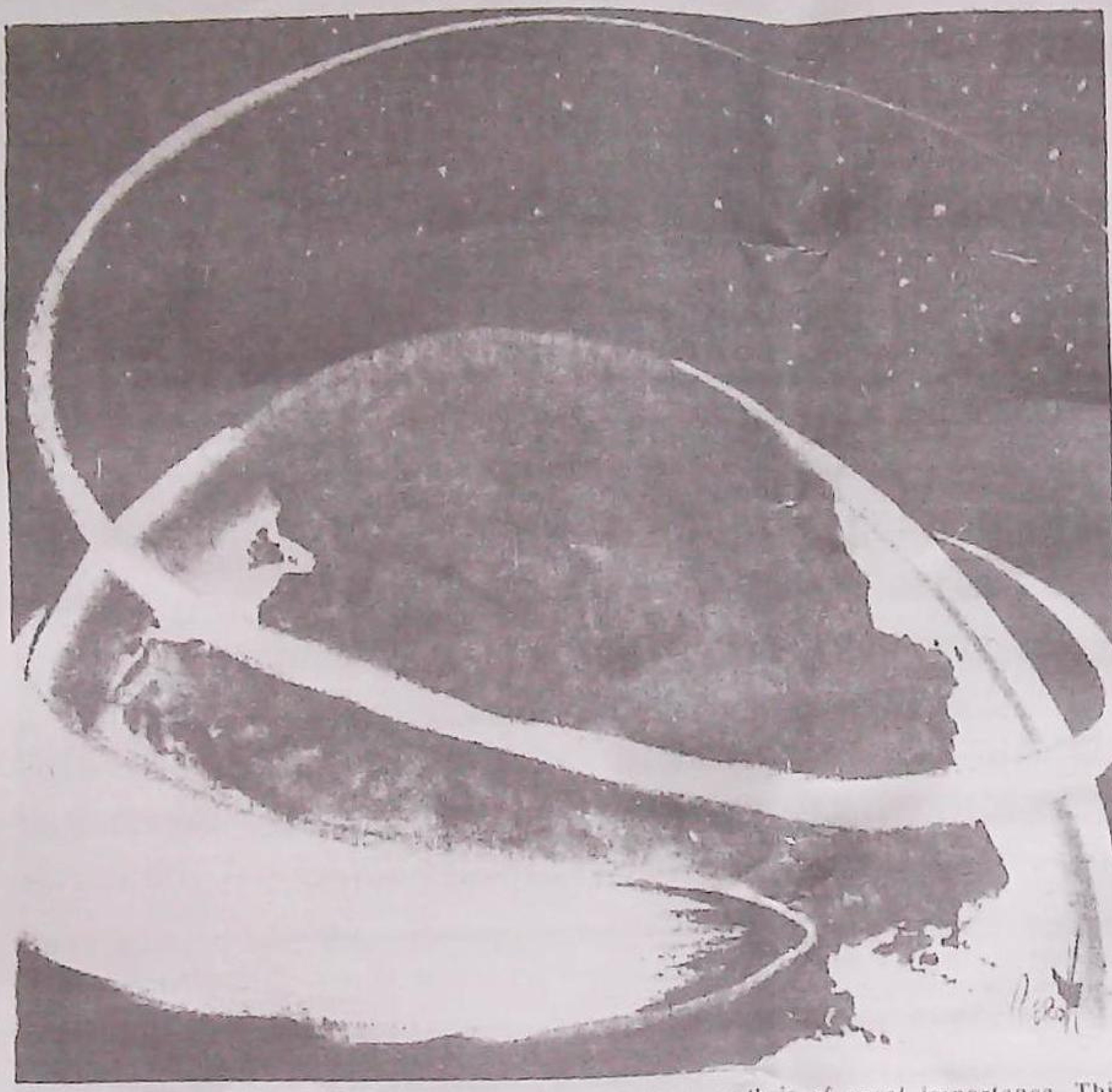
To find out let's examine the job of the artificial satellite. In external shape it may be a sphere, or it may simply be the nose cone of the rocket. Inside its metal skin it harbors a large array of instruments.

One of them will count the number of cosmic rays which hit the satellite. Another will count the number of particles of cosmic dust striking it; larger meteorites, say with a diameter of one eighth of an inch or bigger, are so rare that a hit would be a fantastic coincidence.

Still another instrument will measure to what extent the metal skin is heated by the rays of the sun. This is important to know, just as it is important to know how quickly the skin will cool off when the satellite enters the earth's shadow.

One instrument will measure the strength of the earth's magnetic field. All of them will be hooked up with an automatic radio transmitter which broadcasts the readings to the ground, where stations can receive it and translate the radio impulses into figures with meaning.

This technique—the technical term is "telemetering"—has been developed for use in high altitude rocket shots. The [illegible] for the transmitter will



The artificial satellite will circle the earth every 90 minutes. But for how long is a matter of conjecture. It could stay up there for 450 hours, or 4500 hours or 9000 hours. Its rate of slowing down to the point where it falls to earth is of great importance. This drawing shows the final plunge to the dense layer of air where even reduced speed will cause the satellite to burn up before it reaches earth.

just how much air resistance is left at a certain height. We know, for example, that no satellite could be established at a height of 100 miles. There still is a trace of air up there to slow it down. We are also sure that at a height of 1100 miles the satellite would not be slowed down at all. But what about, say, 200 miles?

Problems at 200 Miles

It has been suggested to put the first satellite at 20 miles. In all probability it would be slowed down after a while, sink into denser layers of the atmosphere and burn up. But would it last for 300 revolutions, or for 3000 or for 6000?

Since every revolution around the earth at that height takes 90 minutes, one could also ask: would it last for 450 hours, or 4500 hours, or 9000 hours?

This is what has to be found out. The time the satellite will remain at a height where it cannot stay permanently, the rate of slowing down and its precise behavior under these conditions are of such importance to science that the experiment would be worthwhile if nothing else were established.

Would Resemble Star

At dawn or dusk, under uncloudy conditions, one will see a pinpoint of light moving directly overhead. The satellite will resemble the ordinary star (except that its light will be a reflection of the sun.)

It is impossible to say now whether the naked eye would be able to judge distance variances from its original orbital path.

Some scientists have even suggested an un-instrumented satellite, just a large plastic foam bubble, for this research purpose. But if you shoot into space you might as well shoot instruments and find out a few other things, too.

Besides, the top stage of the rocket will provide an un-instrumented satellite anyway. Remember that one shot produces two satellites, if the instrument load is separated from the carrying rocket after it gets into space.

Monday: What good are satellites?

Red Sees Life Like Man's On Outer Galaxy Planets

By Verner Forchhammer

COPENHAGEN, Aug. 6 (INS). A leading Soviet astronomer expressed belief today that life can exist on "numerous" planets outside the earth's solar system.

Prof. Kyrill Fedorovich Ogorodnikov, however, doubted that life similar to that on earth would be found on any of the planets within the earth's solar system.

Scientists hope to land space ships on these planets in the next few decades but Ogorodnikov said his compatriots were not even theoretically envisioning the day they will explore the outer galaxy.

To reach these unknown worlds, he said, a space vehicle would have to travel at the speed of light—about 186,300 miles a second. And it is in this outer realm of the galaxy that Ogorodnikov said "there must be numerous planets" that could be inhabited by men.

While the professor is doing his bit to help man reach the moon and beyond, he has no intention of going there himself.

Ogorodnikov said he "certainly would stay on earth" even if the problems of space flight were solved.

The English-speaking scientist who has studied at Harvard University's Yerkes Observatory, is currently a professor at Leningrad University. He is in Denmark for the International Astronautical Federation Congress.

The 55-year-old Russian was asked in an interview about the possibilities of finding a planet in the earth's solar system on which man could live similar to his life on earth. Ogorodnikov expressed doubt, but added:

"Man at that time may have many devices to enable him to eke out an existence on some planet or other."

Asked if a planet allowing life similar to that on earth might be found in solar systems outside the earth's galaxy, he replied: "Certainly there must be numerous planets of that kind."

"Reaching them, however, demands enormous speeds—speeds up to the velocity of light or maybe beyond," he added.

"At present we cannot envisage surpassing the speed of light either theoretically or logically, but who knows what kind of new relativities the future may hold for us."

Billy Graham Preaches Today

Evangelist Billy Graham will preach at the 9 and 11 a. m. services today at the National Presbyterian Church, N st. and Connecticut ave. nw.

Doors will open at 8 a. m. and church members with identification and guests with invitation cards will be admitted up to 8:30 a. m. All others will be admitted after 8:30. Church members with identification will be admitted up to 10:45 a. m. beofre the 11 a. m. service.

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This technique—the technical term is "telemetering"—has been developed for use in high altitude rocket shots. The power for the transmitter will come from the sun; the Bell Laboratories invented their solar battery just in time.

Location of Stations

If the artificial satellite travelled along the Great Circle called equator it would be necessary to build the receiving stations near th equator. Of course they could be Navy vessels or airplanes converted for this purpose. And it would fall short in its poh in being able to transmit only information about conditions over the equator.

But the magnetic field of the earth, as everybody knows, differs with distance from the magnetic pole which is not too far form the real pole. And, which is not well known, the number of cosmic rays also varies with distance from the magnetic pole.

In short, an artificial satellite traveling over the equator would teach us less than one which travelled along a meridian from pole to pole. It may be put into such an orbit, called a "circum-polar orbit," or it may be an orzit which reaches its "highest north" over the Arctic Circle and its farthest south over the Antarctic Circle.

Figures to Be Exact

It must not be imagined that the findings of the artificial satellite will be great surprises to scientists. One might even say jaradoxically that a surprise finding would be a great surprise. When it comes to things like the number of cosmic rays at the distance of the catellite, the scientist knows approximately what to expect. But this is the point—he knows it only approximately. The satellite is to provide precise figures.

One might say that the scientist is in about the position of a man who knows that a certain store is on Fifter ave. between 42d and 52d sts., but does not know the precise address. The satellite's instruments have to establish the correct figures.

One of them is the problem of just how much air resistance is left at a certain height. We know, for example, that no satellite could be established at a height of 100 miles. There still is a trace of air up there to slow it down. We are also sure that at a height of 1100 miles the satellite would not be slowed down at all. But what about, say, 200 miles?

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Astronautical Federation Congress.

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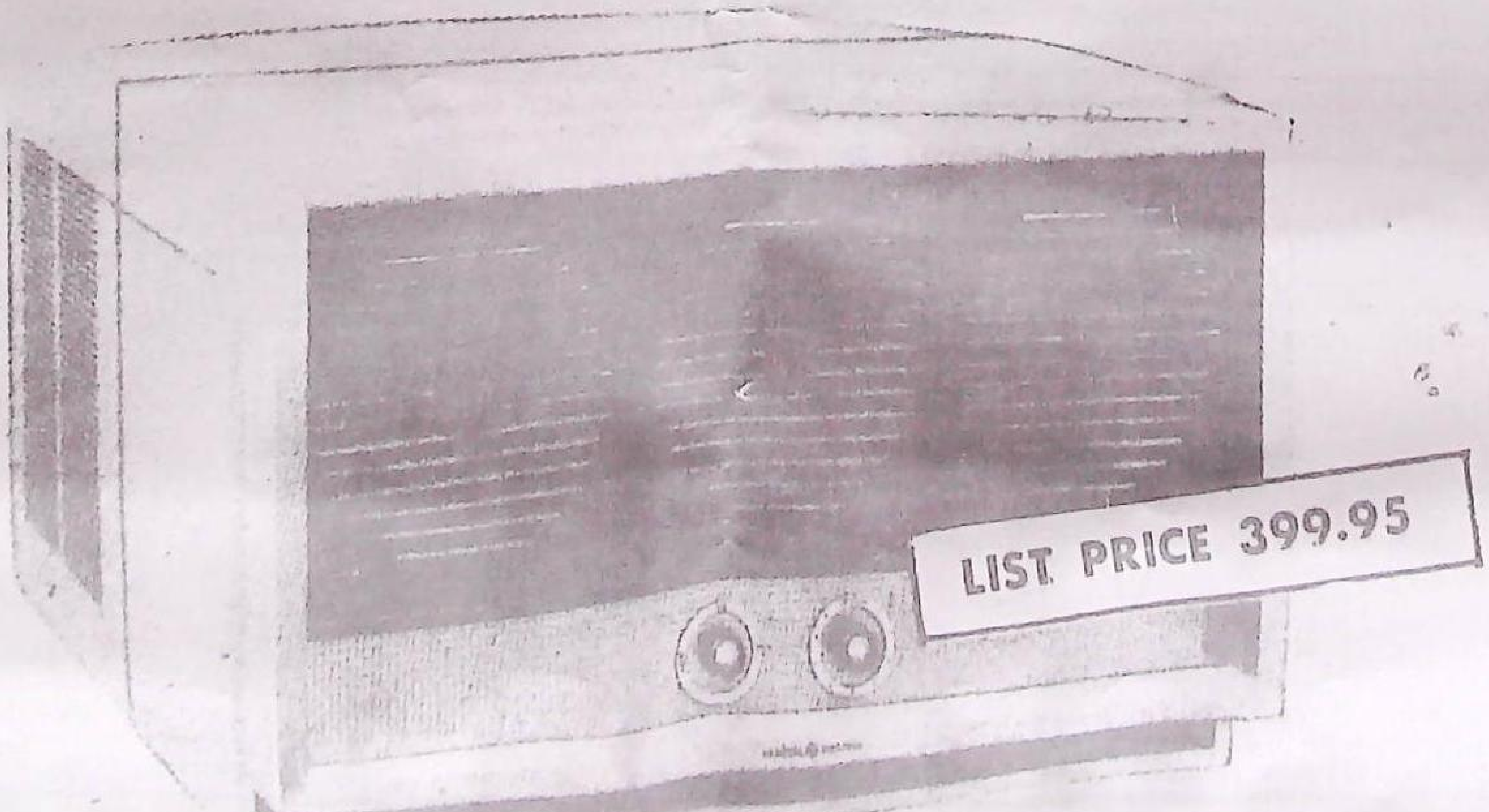

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First Step Into Space Hardest

(Last of a Series)

Past and Future

By Willy Ley

Some sciences began with a more or less accidental discovery and progressed from there. The original discovery was tested and checked, additional discoveries were made and when enough evidence had accumulated a theory to explain the observed facts was constructed.

Rocket research progressed from the other end. In this case theory came first. During the last year of the first World War the American physicist, Prof. Robert H. Goddard, wrote a memorandum on rocket theory which was published in 1920 by the Smithsonian Institution.

At the same time, the German mathematician, Prof. Hermann Oberth, wrote another treatise on rocket theory. It was not only far more technical than Goddard's but also embraced a much larger scope.

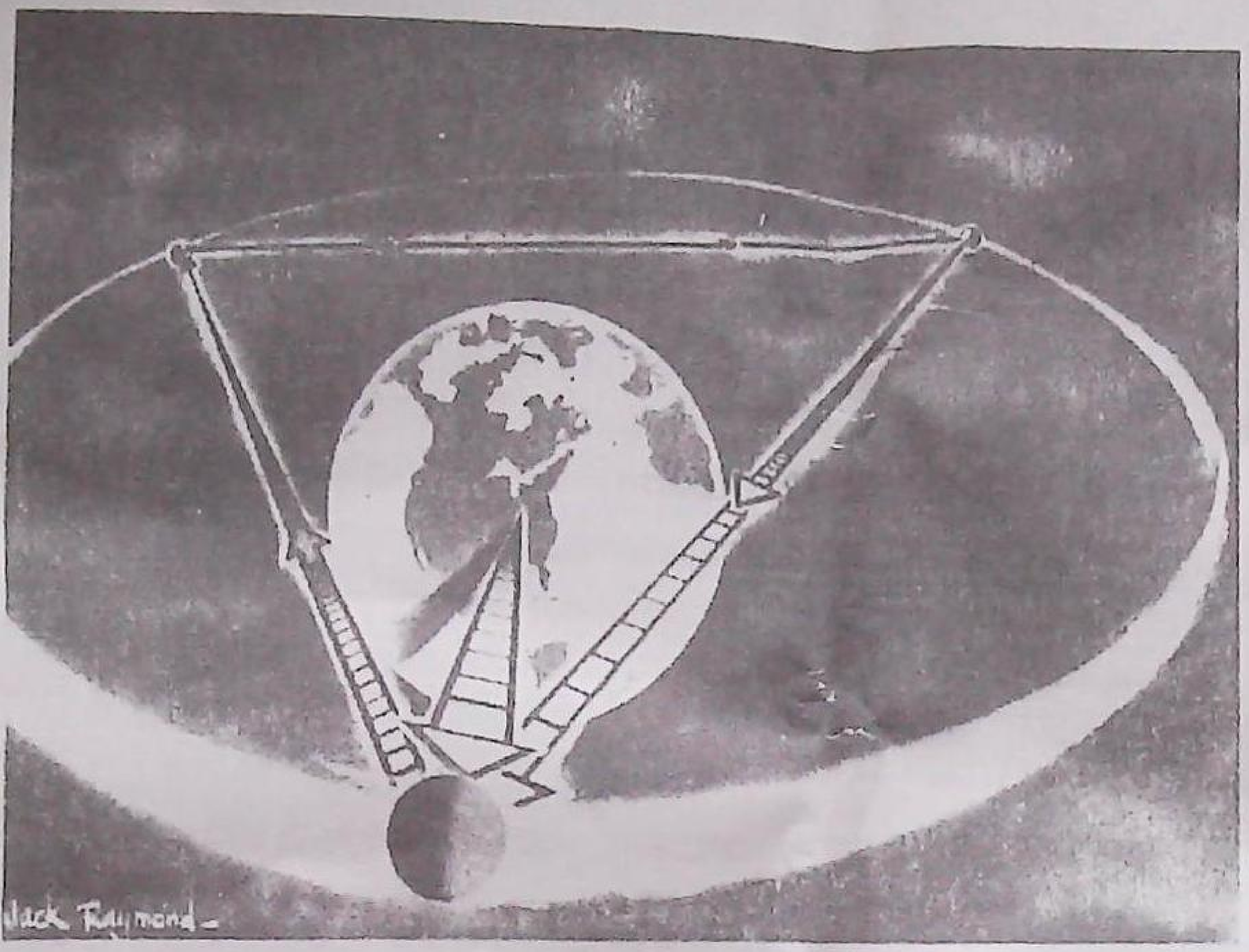
Goddard had gone as far as to investigate the possibility of a rocket shot to the moon, unmanned of course, while Oberth took in the whole field of space travel. His book was published for the first time in Munich in 1923 and readers who had enough staying power to wade through the dense underbrush of Oberth's equations could find a theory of the artificial satellite on almost the last page of the book.

Basis of Modern Research

All modern rocket research is based ultimately on these two works. By 1928 a kind of "program" had been formulated which said that after a number of purely experimental rockets there would be rockets built for the exploration of the upper atmosphere.

Then there would be rockets capable of traveling over long distances, to be used either as mail carriers or for military purposes. After that there would be rockets going to high altitudes with people, or at least a pilot, aboard. These piloted rockets would ultimately go into space and would be used to build a manned space station.

Actual progress has followed the 1928 outline with but two exceptions. The first is that long range rockets have not been used as mail carriers so far and it now appears likely that there will be mail-carrying missiles one day but that they will not be rocket propelled. The other exception is that nobody thought of an unmanned artificial satellite in 1928. That idea is only about 10 years old and originated during the second World War.



Three satellites placed around the earth in the same orbit—each linked with the other and with the ground—can be used as TV and shortwave radio relay stations.

24 Hours to Circle Globe

One of the first suggestions made with regard to unmanned satellites was to use them as relay stations for short wave radio and television. If you put an artificial satellite in an orbit over the equator 22,300 miles from the ground it will need 24 hours to go around the earth once.

Since the earth turns at the same rate the satellite would seem to be suspended over one point of the equator. If three such satellites were placed around the earth in the same orbit, each linked with the ground and with each other, one could have worldwide coverage without the need for any relay station on the ground.

Within a few years engineering will have progressed to the point where this actually can be done. Whether it will be done will not be a matter of engineering but of cost accounting and politics.

Otherwise, older ideas still stand.

After a manned rocket ship has reached space a manned space station will be built, probably at a height of 1075 miles. [illegible] hours to go around the earth [illegible] This manned [illegible] station will be a structure of many jobs. It would be an observatory from which astronomers can search the sky unhampered by any atmosphere.

Watch Cloud Patterns

It would be a place from which meteorologists watch the cloud patterns forming on the earth below to forecast weather on a global scale and possibly weeks in advance. It could be a military observation post.

It could be a research laboratory where important discoveries could be made.

If we continue to push a space research program after the firing of the first artificial satellite we can have such a manned space station in about 10 years.

With the completion of the manned space station the long range goal of space travel will have been very nearly accomplished because that first step into space will be the most difficult portion of the whole task.

To break away from the earth completely requires a velocity of 7 miles per second.

A spaceship which has arrived at the space station and moves alongside the station will have a velocity of 4.4 miles per second.

To leave the earth completely from it it will only have to make up the difference in speed, namely 2.6 miles per second. It is interesting but true—and of course it sounds incredible—that it costs more fuel to go from the ground to the space station 1075 miles above than it does to go from the space station to the moon which is 239,000 miles away.

The moon actually will be the first goal of a trip into space from the vicinity of the station. But the first trip to the moon will be without landing; the rocket ship will merely leave the vicinity of the space station, go to the moon, circle it (cameras clicking and movie cameras busily whirring most of the time) and return to the neighborhood of the station, which it will reach 10 days after departure.

This could be done even with present day fuels some few years after completion of the space station. To attempt to look further into the future than that would be futile for nobody can tell what else will be invented during the [illegible] years between the first artificial satellite and the first trip around the moon.

Democratic Cruise

The National Capital Young Democratic Club will sponsor an all day Chesapeake Bay cruise on August 21 on a chartered sailing schooner. Reservations must be made by Wednesday.

Islands Import Water

CHARLOTTE AMALIE, Virgin Islands, Aug. 8 (AP)—The United States Navy is in the water business here.

It hauls water in from Puerto Rico at $4 a ton. During a one-month period this summer the Navy's barges delivered 11 million gallons—more than $175,000 worth.

For years the small island of St. Thomas has faced a water shortage. All efforts to obtain water by deep well drilling have failed.

Big triangle-shaped cement areas dot the mountain slopes to drain rain into cisterns.

Gov. Archie A. Alexander has anounced a million-dollar program, to be financed by the island, to relieve the water shortage. He has not outlined it in detail other than to say it would include more storage tanks for rainwater and some method of distillation of sea water.

Rainfall in recent years has been below normal and the number of water using tourists has been increasing.

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